U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

PB-245 177

PERFORMANCE CONTROLS FOR SENSITIVE LANDS
A PRACTICAL GUIDE FOR LOCAL ADMINISTRATORS

American Society of Planning Officials

Prepared for
Washington Environmental Research Center

March 1975

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43D, 43I

TECHNICAL REPORT DATA

(Please read Instructions on the reverse before completing)

1. REPORT NO. EPA 600/5-75-005	2.	3. RECIPIENT'S ACCESSION NO.
4. TITLE AND SUBTITLE Performance Controls for Sensitive Lands: A Practical Guide for Local Administrators		5. REPORT DATE March 1975 Date of Approval 6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) Charles Thurow, William Toner, Duncan Erley		8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS American Society of Planning Officials 1313 East 60 Street Chicago, Illinois 60637		10. PROGRAM ELEMENT NO. 1HA098 21 AKL 25 11. ~~CONTRACT~~/GRANT NO. R802443
12. SPONSORING AGENCY NAME AND ADDRESS Washington Environmental Research Center Office of Research and Development U.S. Environmental Protection Agency 401 M Street, S.W. Washington, D.C. 20460		13. TYPE OF REPORT AND PERIOD COVERED Final 14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES

16. ABSTRACT

This report is to be used as a handbook by local planning officials in planning for and regulating the use of five distinct natural areas: streams and creeks, wetlands, woodlands, hillsides, and groundwater and aquifer recharge areas. Each section is devoted to the discussion of local regulation of land use in areas identified as "sensitive"; and each area is discussed in terms of its ecology and value to the public, current regulatory practices, and recommended programs for regulating the area. Also included are appendices showing where and how to go about getting technical assistance from existing governmental agencies and examples of local ordinances for protecting the environmentally sensitive areas.

The final section is a monograph on environmental performance standards, the result of a preliminary study on the feasibility of extending the performance standard concept used in industry to regulation of the environment. Its purpose is to explore this possibility and to suggest new areas for research.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Land Use; Planning Controls, Data Collection, Environment, Water Resources Planning, Analytical Techniques	Water Resources Planning Environment Land Use Planning Controls	06F

PRICES SUBJECT TO CHANGE

18. DISTRIBUTION STATEMENT Release Unlimited	19. SECURITY CLASS *(This Report)* Unclassified	21. NO. OF PAGES 542
	20. SECURITY CLASS *(This page)* Unclassified	22. PRICE ~~$12.50~~ 2.25

EPA Form 2220-1 (9-73)

EPA #600/5-75-005
March 1975

PERFORMANCE CONTROLS FOR SENSITIVE LANDS:
A Practical Guide for Local Administrators

By

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Grant No. R802443
Program Element 1HA098
ROAP 21AKL Task 25

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FOREWORD

The planning and regulation of environmentally sensitive areas is a topic of ever increasing interest as its relevance to the development of national and state land use legislation and to the mandates of different Federal agencies demonstrates. For example, implementation of Sections 208 and 304(e) of the Federal Water Pollution Control Act Amendments of 1972, and the Safe Drinking Water Act of 1974 both require consideration and regulation of activities undertaken on and adjacent to certain categories of sensitive lands.

Although environmentally sensitive lands are often of statewide or regional concern and significance, a large and important role in their regulation can be played by local governments. Many new approaches to regulation have surfaced in recent years, some building upon traditional police power regulation, and others making use of taxation and public investment policy, two other implementation mechanisms available to local governments.

In order to provide technical research support to local governments, as well as to improve the ability of the Agency to evaluate the planning efforts of State, regional and local governments undertaken in response to Agency requirements, the Office of Research and Development of the U.S. Environmental Protection Agency, through its Regional Environmental Management program, is now conducting research in the following general areas:

1. Definition and quantification of the relationship between land use activities and residuals (waste) generation/discharge, specifically what mixes, quantities, and rates of residuals generation and discharge are implied by alternative land use combinations and patterns;
2. Definition and assessment of the effects of "control measures" (i.e., specified management actions which result in a physical change in the quantity, type, timing, or spatial location of residuals discharged to the natural environment) on ambient environmental quality;
3. Evaluation of the costs and effectiveness of alternative "implementation instruments" (i.e., policy mechanisms, such as local zoning powers, tax policy, and capital improvements programs, through which control measures are implemented) to achieve and maintain over time specified levels of environmental quality;
4. Identification and evaluation of alternative institutional arrangements (e.g., level of government, function of government, public/private decision-making, etc.) to effectively manage regional environmental quality; and
5. Development of techniques for the systematic evaluation of alternative regional environmental quality management strategies (i.e., various combinations of control measures, implementation instruments, and institutional arrangements) required by Agency regulatory programs.

As part of this overall research effort, this publication analyzes the use of the local police power for the regulation of streams and creeks, aquifers, wetlands, woodlands, and hillsides. It provides guidance to urban planners and environmental managers in understanding these areas and presents ordinances and regulations which have already been implemented in various local areas.

This study was conducted by Charles Thurow, William Toner, Duncan Erley and their associates at the American Society of Planning Officials, 1313 East 60th Street, Chicago, Illinois 60637 under contract to the Washington Environmental Research Center.

Charles N. Ehler
Program Manager
Regional Environmental Management Program
Washington Environmental Research Center

ABSTRACT

This report is to be used as a handbook by local planning officials in planning for and regulating the use of five distinct natural areas: streams and creeks, wetlands, woodlands, hillsides, and groundwater and aquifer recharge areas. Each section is devoted to the discussion of local regulation of land use in areas identified as "sensitive"; and each area is discussed in terms of its ecology and value to the public, current regulatory practices, and recommended programs for regulating the area. Also included are appendices showing where and how to go about getting technical assistance from existing governmental agencies and examples of local ordinances for protecting the environmentally sensitive areas.

The final section is a monograph on environmental performance standards, the result of a preliminary study on the feasibility of extending the performance standard concept used in industry to regulation of the environment. Its purpose is to explore this possibility and to suggest new areas for research.

This report was submitted in fulfillment of Project Number 73-3, consetract Number R802-443, by the American Society of Planning Officials, under the sponsorship of the Environmental Protection Agency. Work was completed as of October 1974.

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ACKNOWLEDGEMENTS

The authors wish to express their appreciation for the assistance given by many agencies and individuals in writing this report. We would particularly like to thank our members in the American Society of Planning Officials who participated in this project. We received a great number of reports, ordinances, and explanatory letters in response to our requests for information. We appreciate the time it took to pull materials together and write the letters; without this cooperation this type of manual would be impossible to produce. Likewise, we are grateful to the planners whose communities we visited in conjunction with this report. They gave us invaluable insights by explaining the regulatory approaches they have used and candidly evaluating the success they have had.

We would also like to thank the individuals who helped us with their technical expertise in these various environmentally sensitive areas. In particular we would like to thank Barbara Putzer, Harriet Irwin, Virginia Kline, Neil Jacquet of the University of Wisconsin, and Diane Korling of the Illinois Institute of Technology. Also of great value to us for their knowledge of groundwater were William Walker of the Illinois State Water Survey and David Miller of Geraghty and Miller, Inc. These individuals, along with the many who responded to our telephone questions, gave us valuable suggestions about how to approach these sensitive resources.

After the first draft of the report was completed, a group of 10 came to Chicago to review the draft. They spent two days with us, making comments and criticism, and proposing revisions that effected a far better report. The review session participants were: John Allday, Senior Planner,

Orange County, California; Charlotte Bingham, Lecturer, Wheaton College, Norton, Mass.; Jim Miller, Planning Administrator, Pacifica, Calif.; Rodney Mack, Shoreland Management Program, Olympia, Washington; Charles Brandes, Land-Use Analyst, Environmental Quality Council, Helena, Montana; Dick Young, Director, Kane County Environmental Protection Department, Geneva, Illinois; Jon Kusler, Attorney, Orange, Massachusetts; Barbara Bedford, Wetland Specialist, University of Wisconsin; David Miller, Geraghty and Miller, Inc., Port Washington, New York; David Lavine, Director, Connecticut Inland Wetlands Project, Middletown, Connecticut.

During the writing of this report, ASPO staff members reviewed the document several times. Frank Beal, Michael Meshenberg, Conrad Bagne, and Frank Popper read the report more than once and managed to maintain a valuable critical perspective. We would like to thank them as well as the other staff members who helped. We would also like to acknowledge David Bryant, who provided help on writing and editing, and David Doty Design for the illustrations.

Finally, we wish to acknowledge the Environmental Protection Agency, especially Martin Redding and Isabel Reiff, both of EPA's Washington Environmental Research Center. They served as project officers for this report but went beyond that status by giving us suggestions and the time to make the report what we thought it should be.

While the material in this report was reviewed in draft by EPA officials prior to publication, the contents do not necessarily reflect the official views or policy of the U.S. Environmental Protection Agency. The report was prepared under contract to EPA and reflects the views of the contractor, the American Society of Planning Officials, which is solely responsible for the facts and accuracy of the information provided herein.

This report was prepared by the staff of the American Society of Planning Officials as part of its Sponsored Research Program. The ASPO research program is an independent research activity supported by grants and contracts and devoted to advancing public agency planning practice. Individual research reports are not reviewed for approval by the Board of Directors or by the membership of the Society. Israel Stollman, Executive Director; Frank Beal, Deputy Director for Research.

I. CONCLUSIONS

This manual promotes the protection of environmentally sensitive areas by using the police powers invested in municipal and county governments. The goal of any regulatory program is to protect important public interests that would not be otherwise considered. Consequently, this manual identifies the key natural processes of five environmentally sensitive areas which provide important public benefits and suggests means by which these benefits can be maintained by using the basic police powers and zoning powers of local government. In preparing this manual, the authors have analyzed the regulatory programs of some 60 communities, with site visits to 28 of these communities, and held a workshop conference which included local planners, state administrators, scientists, and lawyers. This summary and the following recommendations comprise the findings from this work that underlie many of the specific recommendations and suggestions in the text of the manual.

1. Although the number of communities which have adopted ordinances for environmentally sensitive areas is relatively small, these ordinances are an important development in local land-use control:

-- The ordinances give local government an involvement in development decisions for environmentally sensitive areas which they previously did not have. With this involvement, local governments can play a substantial role in resource protection by controlling some of the externalities of development: reducing public hazards, protecting adjoining property owners, maintaining water quality, and reducing future governmental costs from environmental degradation.

-- The ordinances have refocused land use controls so that they are designed to maintain the natural processes of these environmentally sensitive areas rather than to designate the required use of the land. By refocusing land controls in this way, this work has made the performance orientation in land controls more prominent than has been typical in the past.

-- The shift towards performance orientation in land controls has meant a substantial refinement in a community's ability to identify what aspects of development it needs to control. Instead of maintaining the predominantly negative function of restricting use, a community can identify the positive features of the land it needs to preserve and provide the landowner greater flexibility in his use decisions within this framework.

-- Individually or in combination, these ordinances provide a mechanism by which local governments can make a significant contribution to water quality. Most of the natural processes of the environmentally sensitive areas studied are directly connected to the quantity and quality of both surface and groundwater; combining protection of these areas with controls over erosion and runoff can reduce problems of water pollution from nonpoint sources and water quality problems caused by erratic flow.

2. The design and implementation of these ordinances is well within the capabilities of municipal and county governments. They do not require special state enabling legislation and they do not place a heavy financial burden on the communities for special data systems or staff. The critical factors in developing good ordinances are:

A. Analyzing the natural processes associated with the environmentally sensitive area so that the regulatory mechanisms can be designed to protect the specific functions that are important. The following are a few of the general problems in this area of ordinance design:

-- They sometimes overlook functions that are important to the public objectives of the ordinance. For example, few tree preservation ordinances directly consider the importance of these plant communities to local hydrology.

-- Although many of the ordinances recognize the importance of groundwater, there is little in the ordinances which guarantee the continued supply of clean groundwater.

-- All of the environmentally sensitive areas studied would be helped by the implementation of runoff and erosion control ordinances. The impact of these problems is substantially decreased by controlling them as close to their origins as possible. Erosion and runoff controls are not a substitute for the other ordinances, but they provide an important control element that is often overlooked.

-- In terms of water quality, the present ordinances contribute most to reducing erratic flow and handling problems of turbidity and siltation. They have some effect on chemical pollutants such as hydrocarbons and fertilizers, but these sections of the regulations could be substantially strengthened.

B. Identifying and mapping the critical areas to be protected. Most communities have relied on mapping done by other governmental agencies: specifically, USGS and SCS maps. These maps have been generally satisfactory, but most communities have found it necessary to provide methods of adjusting them for specific site inaccuracies. The use of these maps has also led to narrowly defined protected areas. In the case of wetlands, streams and creeks, and aquifers, the protected areas could be better regulated if a buffer zone were provided around them. This zone would allow different types of development than those in the resource area itself, but the buffer would still be a critical part of their protection.

C. Developing the necessary legal language for writing the ordinance. While there appear to be few legal barriers to these ordinances, there is a general reluctance on the part of local governments to pass these ordinances for fear of legal difficulties, specifically with the taking issue. This concern manifests itself by a desire on the part of local governments for workable ordinances from other communities that have passed court tests on which they can model their own regulatory programs.

3. The ordinances described in this manual are relatively easy to administer. Once the landowners understand how the ordinance works and why it is passed, communities have found a general willingness to operate within their framework. There are, however, two important points about their administration:

-- The majority of ordinances for environmentally sensitive areas depend upon individualized regulation. Each case is decided on its own merits by seeing if it meets the criteria set up in the ordinance. This style of regulation places a heavy burden on the administrative process which can be costly and time consuming for both developers and public officials. These problems can be alleviated by defining the performance criteria as precisely as possible, and identifying in the application procedures the exact type of information that must be submitted in order to effectively evaluate the application.

-- The development of environmental performance standards--specific, measurable levels at which the key functions of the sensitive areas must operate--will substantially reduce the administrative problems of these ordinances. The administration could then be done by having a licensed engineer or hydrologist certify that the development meets those standards. This regulatory approach can presently be done for both runoff control and erosion control, and it has potential for groundwater recharge and aquifer protection.

4. Although none of the programs described in this manual need special state enabling legislation, they offer substantial promise for implementing state and federal programs for critical area protection and water quality protection.

-- Some states have already recognized the potential of these programs by mandating local land use regulations for wetlands, coastal zone areas, shorelands and aquifers. These regulatory techniques have the potential for even greater use in critical area legislation.

-- Inasmuch as they address the problems of nonpoint sources of pollution, they are directly relevant to Section 208 of the Water Pollution Control Act Amendments of 1972. They provide a format by which the requirements of this section of the act could be implemented. Likewise they offer valuable methods for protecting underground water supplies from surface disruption as mandated in the Safe Drinking Water Act.

II. RECOMMENDATIONS

The regulatory programs analyzed in this manual complement EPA's general mission and its work with Section 208 of the Federal Water Pollution Act Amendments of 1972 and the Safe Drinking Water Act of 1974 specifically. Taken as a whole, these programs represent a major thrust by local government to control nonpoint sources of water pollution and maintain areawide water quality. Although there is little knowledge among local agencies about Section 208 or the new concern for protecting underground water supplies, and none of these programs was designed with these specific acts in mind, the programs could be easily adapted to meet guidelines for nonpoint sources of pollution or promote groundwater protection. Consequently, it is within EPA's interest to foster the wider use of these techniques and also to consider their potential when drawing up implementation procedures for Section 208.

The research suggests that the following would be useful:

1. The completion of a series of handbooks dealing with the control of sensitive areas not covered in this report, but which are related to EPA's mission;
2. The provision of technical assistance in the design and development of local regulations.

This work should be concentrated on implementation through regulation by suggesting criteria and standards that could be used in evaluating development for particular sensitive areas; by continuing its development of environmental performance standards; by providing mapping procedures which may make the regulatory districts more adequately fit resource needs; and by providing aids to the legal questions raised by the ordinances. There is a great deal of research and information presently available that is relevant to this type of regulation, but it is not in a form that can be used by local governments in developing regulatory programs.

The Environmental Protection Agency should consider the potential of these regulatory progams for implementing Section 208 by:

1. analyzing what possible changes in these ordinances would make them more sensitive to the requirements of this act;--particularly in terms of chemical pollutants.
2. developing a series of actual case studies of management plans incorporating land use controls to meet the purposes of the act.

Most areawide management plans will need some combination of these various protective ordinances. At the present moment, most communities are working in a single area and the development of methods of linking some of these ordinances together may offer substantial gains.

III. INTRODUCTION

A. Environmentally Sensitive Areas and Land Use Controls

Our attitudes toward land have been changing during the past decade. Previously, land was treated as a commodity--to be bought, bartered, or sold through the real estate market. Land that was not flat and dry was in the way. Where land was cheap, wetlands and hills were left alone; where land was expensive, buildable land was made by flattening, draining, or filling.

Experience, however, has taught us that land is a complicated resource, and the real estate market cannot handle all allocation considerations. The recently publicized troubles in the San Jacinto area outside of Houston, Texas, illustrate the point. The huge concentration of chemical industries along the Houston ship channel have been heavily pumping the sand aquifer that lies under 300 feet of clay in southeastern coastal Texas. As groundwater was extracted faster than it was replaced, the water table dropped. As the water table dropped, segments of the aquifer compacted and the clay layer subsided. In 1971 alone, the land sank six inches. Now after 20 years some residential communities are below high tide levels. To date, the damage to these coastal communities is estimated to be over one billion dollars. The San Jacinto area was treated as real estate without also being treated as land containing a loosely compacted aquifer. Unfortunately, there is no getting out of this mistake. Geologists estimate that even with an alternative source of industrial water the land will continue to subside for another 10 years.[1]

Although gross ecological violations of sensitive land areas have resulted in serious trouble, there are success stories. During the 1950s and the early 1960s, Los Angeles was struck by a series of floods, mud slides, and fire disasters on its graded and denuded hillsides. Lives were lost and structural damage ran into the millions. In 1963, city officials responded with far more exacting land-use regulations designed on the basis of the hillsides' natural capabilities. In 1969, the regulations were tested by severe rain storms. In spite of the fact that 13 per cent of all hillside homes were constructed in the period 1963-1969 and that many of the homes were built in steep slope areas, structural damage from the storms amounted to only $5,000.[2] The lesson is encouraging. If designed with the function of the resource in mind, land-use controls can maintain the quality of sensitive land areas while allowing for compatible development.

San Jacinto and Los Angeles are two dramatic examples of how our environmental concerns are closely related to land-use decisions. Many other communities have had similar experiences with development diminishing their groundwater supplies, sending dirtier water into lakes and streams and destroying important wetland resources. Like Los Angeles, some of these communities have developed active programs for preserving the basic functions of environmentally sensitive land, and like Los Angeles, they have found that land-use controls can make the development process more sensitive to critical land functions.

The U.S. Environmental Protection Agency is interested in these programs because EPA has the potential of contributing significantly to the preservation of our land and water resources. In a recent speech, Russell Train, Administrator of EPA, pointed out that land use is not a new authority for EPA, but a new approach to the responsibilities the agency already has.[3] Consequently, EPA has funded this report, which analyzes the best of these programs.

B. The Need for Local Regulatory Programs

The necessity for governmental involvement in environmentally sensitive land comes from the essentially public character of these land resources. When we talk about the destruction of environmentally sensitive areas we do not mean just the possible loss of some "intrinsic" environmental values or benefits, but also loss to the social and economic welfare of a community. Environmentally sensitive areas are land areas whose destruction or disturbance will immediately effect the life of a community by either (1) creating hazards such as flooding and landslides, or (2) destroying important public resources such as water supplies and the water quality of lakes and rivers, or (3) wasting important productive lands and renewable resources. Each of these threatens the general welfare of a community and results in economic loss. The direct costs of not protecting these areas can be high. In the private sector, costs may include the reduction of property value or the actual destruction of property; in the public sector, they include finding alternative sources of water or installing expensive storm sewers and water purification systems.

The need for local regulation comes not only from the public character of the resources, but also from the fact that the real estate market does not adequately consider these costs and benefits. The functions of these environmentally sensitive areas are what economist call public goods--if they are provided for one person, they are provided for everyone. A wetland, for example, filters sediment and traps nutrients from upland runoff, thus cleaning water before it enters adjacent water bodies. These are important functions, but the landowner cannot sell this filtering capacity of his land. If the land is providing a cleaner lake for one man, it is providing it for all the people who use and enjoy the lake. Thus in terms of maximizing his own profits, he may be better off to drain and fill the wetland so he will have more sellable land, but the community as a whole will have to absorb the cost of lowered water quality.

Because these land areas involve important public costs and benefits which are inadequately considered by the normal market mechanism, it is logical that communities would turn to their police powers for protecting the health, safety and welfare of the community. By developing ordinances protecting the functions of these areas, the communities can balance the public interests with the landowner's desires to use his property.

C. The Nature and Character of Local Regulatory Programs

This manual analyzes regulatory programs for five common "problem" areas: small watersheds of streams and creeks, aquifers, wetlands, woodlands, and hillsides. All five categories are environmentally sensitive areas as defined above. They provide important public benefits because of their physical and ecological functions, and their disturbance or destruction results in loss to a community. While each land type has its own range of functions and benefits, the common characteristics of all five areas is their importance to water resources. The wise use of these areas will help preserve the natural flow of clean water from uplands into adjacent surface water and into groundwater reservoirs; the unwise use will result in more erratic flow of dirtier water into lakes and rivers, and in turn, diminish and pollute groundwater resources.

The public objectives of the regulatory program for these land areas are well within the mainstream of land-use controls. Their purpose statements include many traditional public objectives: (1) the protection of public safety by reducing the risk of landslides, flooding, and drought; (2) the prevention of nuisance-like uses of land by controlling erosion, runoff, and water pollution; and (3) the reduction of future governmental costs by preserving public water supplies. All of these are long-term, consistent public objectives which provide sufficient grounds for justifying increased governmental involvement in land-use decisions.[4]

The regulatory procedures used in these programs are also common. Most are zoning ordinances which define a special district or an overlay district. They establish a list of permitted uses, prohibited acts, and special-use or conditional-use procedures. Where permits are required, the ordinances employ review by the planning agency and other appropriate agencies with the final authority resting in the legislative body.

What is new in these regulatory programs is the shift of land-use controls from a primary focus on what is on the land to one of how the land functions. The goals of these ordinances are not to specify a particular use of the land or to segregate uses; that is generally left to traditional residential, commercial, and industrial zoning. Instead, they guarantee that important land functions continue to operate while the land is used, no matter what the use.

Because of this refocusing, these ordinances have made some marked changes in the operation of land-use controls. Generally, this change can be characterized by a movement away from detailed specifications concerning construction techniques or site requirements and a movement toward performance criteria for land use.

Detailed specifications generally are inadequate for this land area, and are also in basic conflict with the philosophy of the ordinances. They are inadequate because the functions of these resources are higly localized. Even within one category, the functions will vary from site to site due to local conditions: how the resource interacts with surrounding ecological and physical systems, what forces have had an impact on the resource, and whether it is relatively pristine or is in the process of adjusting to disturbances. Consequently, there is no one optimal method for treating all wetlands or all hillsides or all stream corridors. Likewise specifying methods of development or site preparation goes against the grain of these ordinances. As much as they are designed to encourage compatible development, it is in the public interest to encourage technological innovation and experimentation which will make development more compatible. By stipulating specific construction techniques or site design methods, a community closes off the possibility of the developer finding better techniques.

Because of shortcomings of specification the regulatory programs have moved towards more performance orientation. The community establishes the way it wants the land to perform, and then it allows the developer to select a method to meet these performance criteria. The most common way of establishing this performance orientation is set out in a series of policy statements that define how the community expects the land to function, and then the regulation itself is individualized--each case is judged on its own merits of whether or not it meets the policies outlined in the ordinance. The alternative to this method is environmental performance standards. In this case, the community sets a specific, measurable level at which the key functions of the sensitive area must operate, and then the developer is required to show that the development will meet these standards.

The strength of the policy approach is that it guarantees governmental involvement in any substantial alteration of these sensitive areas. In this style of ordinance, the permitted-use list together with the statement of prohibited acts simply state that there can be no substantial land conversion without permission from the regulatory body. The permitted-use list includes only those activities which do not require any alteration of topography and entail only minimal construction--recreation, farming, conservation. The guts of the ordinance is its special-use or conditional-use provisions. Here the community outlines the criteria or basic public objectives that must be met in order for the land to be developed. Wetland districts, for example, typically require that development will not substantially reduce the natural retention and storage capacity of any watercourse, and that drainage be designed to prevent erosion and deleterious surface runoff. These policies provide guidelines by which each development is judged.

The weakness of this style of regulation is that it places heavy emphasis on the ordinance administration, which can be costly and time consuming for both the public officials and developers. Generally, in order to obtain a permit, a developer must go through review by a number of local agencies besides the planning department, and often the legislative body is directly involved in the final decisions on each case. This review process requires time and expertise on the part of the developer, the planner, and the public officials.

In contrast, environmental performance standard regulation rationalizes and simplifies the administrative process. In this style of regulation, lists of permitted and prohibited acts are irrelevant. Any use of the land must meet the specific standards established by the ordinances. In order to develop land, the landowner must simply have his development certified by a licensed engineer or hydrologist as meeting the public standards. If, after development, it does not meet the standards, then there is a set of penalties and corrective measures to which the developer is subject.

Although environmental performance standards offer many benefits to regulating sensitive environmental areas, they are still in the early stages of development. In many cases, the difficulty of establishing precise measures for land functions has hampered the development. The areas in which the technique has the most immediate applicability is the control of runoff. The rate of runoff from various levels of development can be readily established, and several communities have designed ordinances which require development to maintain the same runoff coefficient as the land would have if it were not developed. Other areas which have potential for performance standard regulation are erosion control and aquifer recharge. (For a detailed discussion of environmental performance standards, see Appendix A, page 440.)

D. Improving Local Regulatory Programs

Any evaluation of these ordinances must remember the larger context of local land-use regulation. Communities which have developed regulatory programs for environmentally sensitive areas are few and the programs are recent. Some, such as hillside regulations, have had the advantage of a decade of development, but most have been passed only in the last two or three years. In some rural counties, these ordinances are the first land controls to be used. Although new, these ordinances have a vitality and quality that needs to be praised. All the programs studied provide clear public policy guidelines and establish viable procedures which give local government sound involvement in development decisions.

Although good, there is still room for improvement. This manual analyzes the ordinances by defining the key functions of the areas they are protecting and then seeing how they could be refined to protect these functions more closely. In this analysis there are some general patterns that can be noted here:

1. There is a general need to define the functions of these environmentally sensitive lands more precisely. By defining why the areas are important, the regulatory methods can be refined. A prime example is tree preservation ordinances. Usually these are designed to keep a general distribution of trees throughout the community by protecting trees above a certain trunk diameter or requiring a set number of trees per acre. This general distribution will help maintain the microclimate effects of trees (their ability to moderate temperature and reduce the force of winds), but it may not preserve their importance to soil stability and water quality. In this case, the ordinances need to be refined to include considerations of topography and the effect tree removal may have on erosion

creased flow of surface waters. The most important trees may not be the largest, but those located along the drainage patterns and on steep slopes.

2. In setting the boundaries necessary to establish regulatory programs, communities have a tendency to be too limited in their definitions of the resources. These boundary considerations are particularly crucial to wetlands and streams and creeks. These resources are dramatically influenced by the uplands that immediately surround them, and their protection can be strengthened by establishing a buffer zone around them. The land use requirements in the buffer area do not need to be the same for the wetland or streambed, but are equally vital.

3. There needs to be more recognition of the importance of runoff to all of these environmentally sensitive areas. The rate of runoff along with the amount of sediment and chemical pollutants it carries is crucial to the health of all these areas. Controlling these processes through erosion and runoff ordinances will significantly lessen the problems a community has maintaining groundwater recharge, wetlands, and streams and creeks. These ordinances are not a substitute for protecting the areas themselves; instead they provide an important link to sensitive area protection that is often overlooked.

E. Local Regulation in the Context of State and Federal Legislation

All of the programs analyzed in this manual have been developed using basic zoning enabling legislation and the general police powers of local government; none of them needs special state enabling legislation. Some have been developed in response to state activities to protect sensitive areas, but just as often they represent simultaneous and independent action on the part of local government.

The crucial fact, however, is that these programs offer important implementation techniques for both state and federal concerns for environmentally sensitve lands and water quality. These ordinances, individually or in combination, could help preserve the integrity of watersheds, reduce the erratic flows of water in rivers and lakes, alleviate problems of heavy sediment loads in water courses, and preserve groundwater recharge. Likewise, the general adoption of these ordinances would go a long way in preserving the productivity of such resources as wetlands and reduce the problems of hillside development and coastal zone development.

These programs are particularly significant because they offer a means of controlling problems that arise from general development. Section 208 of the Federal Water Pollution Control Amendments of 1972 requires management planning in areas experiencing water quality problems. In the draft guidelines to the management plans, the U.S. Environmental Protection Agency places heavy emphasis on controlling nonpoint sources of pollution, such as runoff and erosion. The ordinances also have potential for protecting water supplies from contamination through uses in the recharge areas as required in the Safe Drinking Water Act. The programs described here could be adapted to meet the requirements of these acts.

The same is true for sensitive area legislation at both the federal and state level. Concern to protect the coastal zone or important wetlands or shorelands can all benefit from encouraging these regulatory programs at the local level. Some states are already moving in this direction. Massachusetts, Connecticut, and Virginia all have state wetland acts which mandate the development of local programs; Washington has passed a shoreland act which requires each county to develop regulatory programs for protecting all the shorelines of the state; and North Carolina passed a coastal zone act this past year which requires its 20 coastal counties to adopt zoning plans. These are just a few examples of the wide variety of state programs that can benefit from these regulations which are being developed at the local level.

F. About This Manual

This manual promotes the protection of environmentally sensitive areas by using the police powers invested in municipal and county governments. This is only one of many techniques available for dealing with such natural resources as wetlands, hillsides, and wooded areas. The public acquisition of land, providing or withholding public capital investments, manipulating tax policies, or establishing total community growth strategies, all could be used for protecting sensitive areas. Any single community is likely to use a combination of techniques, depending upon its particular needs. The focus of this report is on police power techniques because they do not require changes in state enabling legislation, they do not demand heavy expenditures, and they have proved to be effective for resource protection in the communities implementing these programs.

It is not a comprehensive analysis of all environmentally sensitive areas. For some areas, such as floodplain controls, there is already a substantial body for high-quality material available.[5] In other cases, such as major river basins and large lakes, the size and characteristics of the resource require work on a regional scale. Each chapter addresses one of five sensitive areas where local governments make an immediate, recognizable impact, but where their work is hampered by the lack of helpful material.

Thus, even though the report is not comprehensive, it provides local government the assurance that implementation of the ideas it presents will lead to substantial improvement in local environmental quality.

The goal of the report is to encourage more local governments to institute active, effective programs like those analyzed. It is not an ecology textbook or a book which tells planners how to do environmental analysis; instead, it is a book on how to develop regulations. It presents a process by which one can move from basic ecological principles to public policy decisions and finally to implementation of those decisions by designating regulatory mechanisms. Therefore, it is addressed to local units of government, and specifically to planners, public officials and citizens interested in or actually developing ordinances.

Each chapter, then, is organized in the following manner:

1. First there is a basic overview of the environmentally sensitive area.

2. The second section outlines some of the basic principles about the functions of these areas which make them important public resources. In presenting these principles, the concern is primarily with identifying their relationship to public policy objectives.

3. The third section of each chapter evaluates the best current local regulations on the basis of how well they are designed to protect the specific functions of the area and how easy they are to administer.

4. Finally, each chapter concludes with a section recommending methods for developing local programs for that particular sensitive area, examples of ordinances, and sources of information.

NOTES

1. New York Times, June 27, 1974, p. 59.

2. Charles A. Yelverton, "The Role of Local Governments in Urban Geology," Environmental Planning and Geology in the Urban Environment, ed. by Donald R. Nichols and Catherine C. Campbell (Washington, D.C.: U.S. Government Printing Office, 1971), pp. 80-81.

3. New York Times, July 9, 1974, p. 10.

4. For good discussions of the legal issues involved in these ordinances see: Jon A. Kusler, "Open Space Zoning: Valid Regulation or Invalid Taking," Minnesota Law Review, 57:1 (November, 1972), pp. 1-81; Ira Michael Heyman, "Innovative Land Regulation and Comprehensive Planning," Santa Clara Lawyer 13 (1972), pp. 183-235; and Fred Bosselman, David Callies and John Banta, The Taking Issue (Washington, D.C.: Government Printing Office, 1973).

5. See Regulation of Flood Hazard Areas to Reduce Flood Losses, United States Water Resources Council, 1972.

SECTION IV

STREAMS AND CREEKS

A. Introduction

The experience of a hypothetical community's problems with its water resources makes the importance of land-use control in the management of streams and creeks clear. Watertown, like most growing areas, has allowed extensive development of its surrounding hillsides, woodlands, and wetlands. Poorly regulated development in these areas of the watershed--that area of land drained by Watertown Creek--has removed much of the hillside vegetation, graded and leveled hills, and used the removed soil to fill in adjacent marshes and bogs. As a result, Watertown Creek has become choked with the erosion from the hillsides, as have the remaining marshes. Lack of protective vegative cover, and the many impervious surfaces of buildings, roads, and parking lots have increased runoff and flooding of Watertown Creek, already above its natural level because of the increased sediment in its bed. Moreover, with the natural filtering system of the marshes destroyed by fill and sedimentation and the increased pollution from land fill sites, lawn fertilizers, and faulty sewage systems, Watertown Creek has become a health hazard. The choking of the creek with polluted, sediment-laden runoff has decreased and degraded the amount of water which the creek adds to groundwater supplies, thus causing several city wells to run dry and others to be threatened with pollution.

Watertown is of course in an unusually bad state with a flood-prone creek and a polluted and diminishing water supply. Few communities experience such simultaneous disasters, but many have similar problems. Watertown must now underwrite a bond issue and appeal for federal and state assistance in order to protect itself from floods and replenish and clean up its water supply. The necessary dams and levees, treatment plants, and, perhaps, an aquaduct from Pleasant Valley Creek over the hill, will be expensive and will not prevent future problems. However, careful regulation of land use in the watershed of Watertown Creek in the first place could have made such remedial measures unnecessary and saved the community much economic and environmental damage. Thus, along with its remedial cleanup and protective programs, Watertown also plans a land-use control ordinance to regulate development in the Watertown Creek watershed so that its already serious problems do not grow.

Decisions to allow the development of a steep hillside or to drain a marshland and cover it with parking lots and buildings can be major causes of pollution or flooding. Instead of undertaking expensive treatment of polluted water or equally expensive and perhaps environmentally unsound leveeing of a stream, land-use regulation in the watershed area can control those developments which may increase pollution or flood hazards. Of course, many communities already have such problems, and remedial action will still be necessary to solve them. Remedial action, if accompanied by preventative land-use control, cannot only clean up polluted streams and afford flood protection, but also assure that such problems, as they are solved by remedial efforts, will not be repeated.

B. Streams and Creeks and the Public Purpose

Many communities learn about their surface water the hard way--after it is polluted or depleted or poses threats from flooding. Then such communities measure the value of their water resources by the amount of money necessary to restore their health. But there are other ways of realizing how streams and creeks serve the public purpose. What are these positive contributions? Here are some:

1. Streams and creeks affect the quantity of a community's water resources. Increased runoff and sedimentation from watershed development can cause irregular flow and choke a stream's connection with groundwater formations, thus creating low and irregular groundwater resources. Similar effects can be seen in lakes and rivers.

2. Streams and creeks affect the quality of a community's water resources. As a source for groundwater recharge, river flow, and reservoir storage, clean water in streams and creeks is an important resource.

3. Streams and creeks contribute to overall environmental health. Streams and creeks are major corridors for transporting nutrients and sediments, as well as pathways for many species of birds and animals. They bind together diverse ecological communities such as hillsides, woodlands and wetlands with the shared resource of water, and they are intricate parts of the hydrological and nutrient cycles.

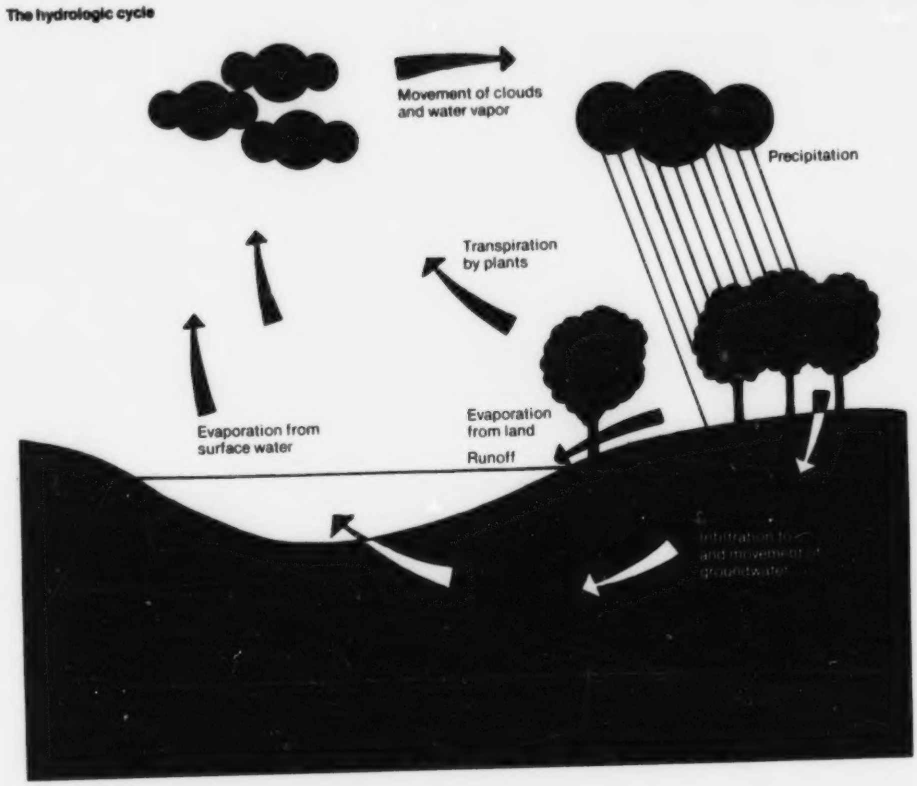
If local communities are to protect and conserve the resources of streams and creeks they must (1) not only consider the watercourses themselves but look beyond the immediate stream bed, (2) consider the watershed, that area of land the stream drains and flows through and (3) the wetlands, lakes, reservoirs, groundwater resources and other streams and rivers it feeds. Because of the intricate relationship of streams and creeks to so many environmental communities and processes, healthy watercourses serve as an index to the health of the entire watershed. Thus this section on streams and creeks is an introduction to the possible effects of development upon the many positive values provided by various critical environmental areas.

1. Effects Upon Water Quantity

A stream is an important part of the hydrological cycle--the circular path which water takes as it falls in the form of snow or rain, penetrates into groundwater reserves, collects in lakes, streams, and oceans, and is evaporated by the sun or transpired by plants back into the atmosphere. Within this cycle water follows three major paths. Precipitation may penetrate through rocks and soils, where it is stored in groundwater reservoirs or aquifers from which it later comes to the surface at springs or wells or flows into wetlands and surface water bodies. Or, rain or snow (after it melts) may run off the surface of a hill or plain, collecting in creeks, streams, and rivers, where it flows into lakes, wetlands, and the ocean. Finally, the water returns to the atmosphere by evapotranspiration--either it is transpired by plants or evaporated from the surface by the sun. (See Figure IV-1.)

Streams and creeks play two parts in this cycle. Most obviously they are the major drainage systems of earth's surface, conducting runoff water

Figure IV-1


The hydrologic cycle
Movement of clouds and water vapor
Precipitation
Transpiration by plants
Evaporation from surface water
Evaporation from land
Runoff
Infiltration to and movement of groundwater

and sediments from highlands to low-lying land or water bodies. Streams get their water from two sources--rainfall and groundwater. Those that depend mainly on rainfall occasionally may run dry during dry seasons and are called intermittent streams. Those that are supplemented by groundwater usually run in all seasons. Small streams and their drainage areas (or watershed) of 100 acres or a few square miles combine into larger drainage systems of major rivers to then eventually outflow into major lakes--such as the Great Lakes--or oceans.

The relationship with groundwater is the second major role played by streams in the hydrologic cycle. Aquifers may discharge groundwater into streams from springs or seepage during periods of low flow; and during the wet season, the stream may contribute water to the aquifer. Thus streams are important sources of groundwater recharge, and groundwater is an occasional source of supplementary stream flow, especially in the Southwest. Streams and aquifers form an interlocking system of surface and groundwater resources, and the pollution or degradation of one will eventually affect the other.

These two roles of streams in the hydrologic cycle make them an integral part of our water resources. Many communities' water supplies depend upon wells drilled into groundwater reservoirs, most of which are replenished in part by infiltration from streams. Development of watershed and land alongside streams can disturb this natural process. As we shall see, increased runoff from developed land increases erosion and sedimentation. Heavy siltation of the streambed can clog the transmitting formation, making the streambed less able to allow surface water to infiltrate into groundwater reserves. Also, polluted runoff from upland development or direct discharge into a stream can infiltrate the groundwater, thereby polluting underground water resources as well.

Development in the watershed can also alter the relationship between streams and groundwater by affecting the peak and base flows of a stream, which mark the high and low volumes of flow according to precipitation or melting patterns. An increase in impervious surfaces, such as roads and roofs, accelerates runoff by releasing precipitation which would otherwise be absorbed by the soil, and the heat from their surfaces increases the melting rate of snow and ice. Similarly, destruction of vegetation and wetlands, which absorb some precipitation (woodlands also shade snow and ice, moderating the rate of melting), will increase the rate of runoff. As a result, precipitation passes too quickly through groundwater channels, increasing the rate of stream flow, making it irregular with low base flows and high peak flows. Thus, dependent groundwater reservoirs will also fluctuate, depriving a community of a stable supply of water.

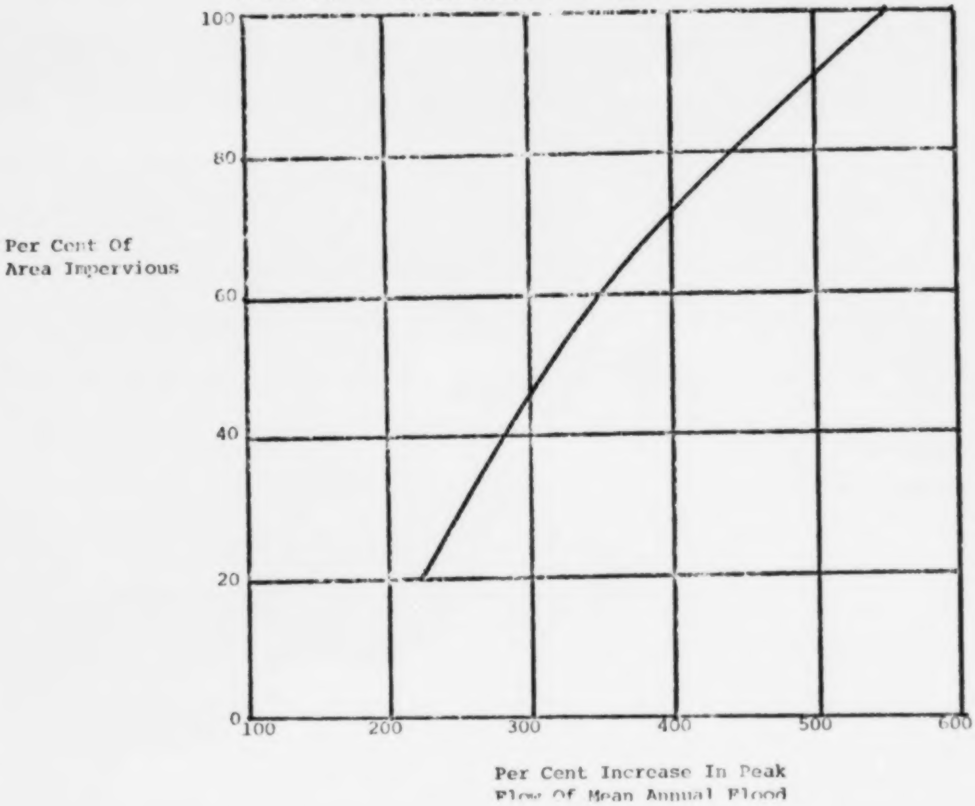
Developmental effects on the rate of peak and base flows of a stream also increase the level of flooding by altering the character of the watershed so that too much water runs off at one time. Figure IV-2 shows the relationship between flooding and the per cent of impervious surfaces in a watershed.

Moreover, increased sedimentation, associated with rapid runoff, is deposited in the streambed, thus raising the bed and the level of flood waters. Increased runoff is a particular problem in areas of heavy seasonal rainfall, such as the Southwest or in mountainous areas with heavy spring meltwaters such as the Rocky Mountain, Pacific Coast, and Applachian states.

In a natural state, a stream can handle the rate of runoff from any average rainfall. This does not mean that flooding is an unnatural phenomenon; it regularly occurs to some extent in all streams during periods of heavy pre-

FIGURE IV-2[1]

THE EFFECT OF URBANIZATION ON FLOODING



* 60% of area served by storm sewerage

cipitation and melting. But the flooding is seldom catastrophic, thanks to the moderating effects of vegetation, soil and organic litter, and wetlands. Disturbance of these moderators of runoff can produce unnaturally high and occasionally catastrophic flooding. Thus an important part of a community's flood control program includes regulation of development in sensitive environmental areas such as hillsides, woodlands, and wetlands.

If a community wants to maintain a stable surface and groundwater supply as well as minimize the damages of flooding, it will create a land use policy to regulate development in the watershed so that protective soils, vegetation, and wetlands are maintained and runoff is not significantly increased by too many roads and other impervious surfaces. Of course, the total watershed may lie outside an affected community's jurisdiction. In this case cooperative county and regional policies can be developed.[2]

2. Effects on Water Quality

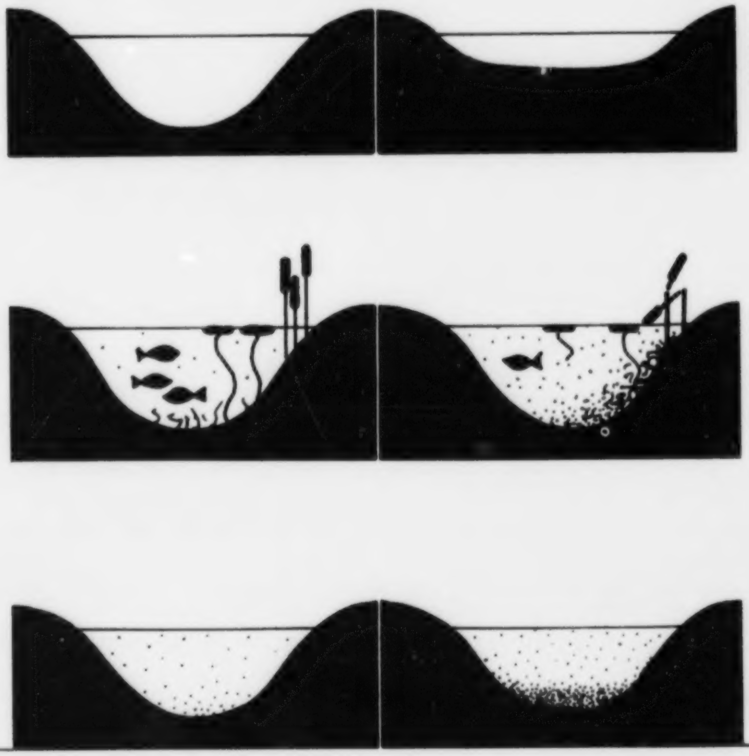
Streams transport the soils created by weathering or dislodged by running water from the upland portions of the watershed and deposit them along their banks downstream. During high water and rapid flow, large quantities of sediment are thus transported, creating floodplains and deltas where they are deposited. These alluvial soils, such as those along the Mississippi River, create some of our most productive agricultural areas.

The amount of sediment or suspended particles a stream can carry depends in large part upon the rate of flow, which is usually measured in gallons per minute or cubic feet per second. Water of high velocity is able to carry more particles than slower moving water. Thus rapid runoff is associated with increased erosion and sedimentation. Once the rate of flow decreases, heavier particles such as gravels and sand settle out and are deposited along stream banks and flood plains or in stream beds. In even quieter water, where a stream enters a lake or marsh, or where there are still stretches of a stream, finer particles such as clay and silt settle out and are deposited.

The rate and amount of sedimentation a stream can carry is balanced by the rate of upland erosion, the amount of runoff, and the geometry of the stream itself. Changes in any of these factors, as shown in Figure IV-3, can have far-reaching effects upon the stream. In general, stream

Figure IV-3

Stream properties



Deep stream bed usually means high velocity and scoured rock bottom

Shallow stream bed usually means low velocity and less scoured, sediment prone bottom

Under natural conditions use of nutrients, oxygen and other stream resources by wildlife, plant life and decomposing matter is at an equilibrium

With increased runoff, organic matter in the water increases and uses much of the total oxygen in decomposing– fish decline, algae proliferates

Under natural conditions a stream can efficiently transport the sediment deposited by natural erosion and runoff

When increased runoff increases the sediment load above the natural capacity of the stream, the sediment settles out and is deposited on the stream bottom geometry--the shape and depth of a watercourse--is determined by rate of flow, sediment load, and the composition of the rocks or soils the stream cuts through. Deep stream beds have high rates of flow, and the fast moving water, together with the particles it carries, act to scour and clean the stream channel, flushing out sediments and organic matter. Shallower streams with lower rates of flow are more likely to have beds composed of deposited sediments and cannot so easily flush out sediments and pollutants. Flooding in all streams, especially shallow ones, is an important cleaning process. Thus making a stream completely safe from flooding by extensive dams and water control can allow a stream to become choked with sediment and increased pollutants and debris.

Increased erosion and highly irregular flow, can have a similar effect upon streams. As Figure IV-3 shows, increased sedimentation has serious results. It may increase the turbidity--the amount of suspended particles in the water--cutting down the light reaching lower parts of the stream and thus killing many species of plants and animals. Such organic debris, including that added by more runoff but not flushed out by stream flow, increases the number of decomposing bacteria which use up the available oxygen, contributing even more to stream pollution. The result is an algae-choked, biologically depleted stream, a far cry from the healthy stream which can carry and dispose of a limited amount of sediment and organic debris.

Increased sedimentation of a stream bed increases flood levels and interferes with groundwater recharge, and it can also alter the entire course of a stream. Most drainage patterns are relatively stable, with only gradual alteration of stream channels. However, increased sedimentation of a stream bed can force the stream to seek a new channel, resulting in additional erosion and problems from sedimentation.

Heavy sedimentation of stream beds creates special problems in harbors and navigable waterways by choking the channels used by boats and ships. Sedimentation, especially in coastal areas, also destroys spawning and feeding grounds for aquatic life--especially for many species of game and food fish as well as for shellfish such as oysters, mussels, and clams.

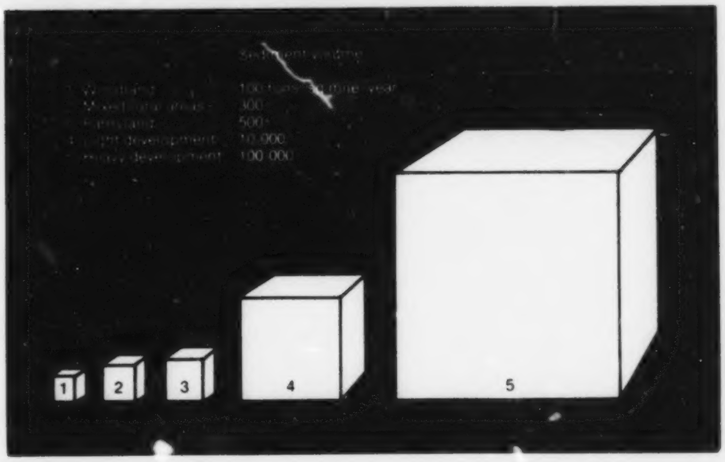
The typical remedial technique for sediment-choked streams involves dredging the channel or harbor, creating additional problems with disposal of the sediment removed. Dredging does not, however, prevent new sedimentation, and it is thus necessary to repeat such operations periodically.

The real cause of increased sedimentation lies, of course, in the watershed. Development of upstream areas can increase runoff and erosion by removing vegetation, whose roots, leaves, and litter retard erosion, or by massive construction practices which grade hillsides, remove topsoil, and leave large areas of land bare and vulnerable to erosion during construction. A Maryland study of construction impact on erosion levels found increases from 3 to 100 times the sediment yield of dominantly rural or natural areas as compared to areas undergoing development.[3] Figure IV-4 shows the amount of sediment produced by natural, agricultural, and urban areas and areas under construction.

The most critical problem of sedimentation occurs during the early construction stages when its topsoil is stripped and subject to erosion

Figure IV-4[4]

Volumes of sediment eroded from land of different uses



from running water. The severity of the problem depends upon previous land use, the gradient, the length of the slope, the type of impervious and pervious cover. For example, forested cover once removed may release far more sediment than a disturbed agricultural area. As the degree of slope and its length increases, so does the sediment production potential. And certain soil types are more sensitive than others.

Not only does rapid runoff accelerate the process of upland erosion, it also speeds up the erosive power of the stream itself by increasing the rate of flow. A fast-flowing stream fed by rapid runoff will cut deep into its banks, especially if they are composed of easily eroded soil. Not only is the sediment load thereby increased, but shading and bank stability may be destroyed. The loss of shading vegetation will increase water temperature. And as the stream cuts into its banks, it widens its bed, slowing the flow of water and accelerating sediment deposition.

A rapidly flowing stream with serious bank erosion is frequently channelized in order to prevent further bank erosion. Like dredging, this is a remedial measure with serious environmental side effects. A channelized stream may flow even faster, affecting unprotected downstream areas, and destroying habitats for fish and aquatic life.

Along with loss of shading vegetation as a result of stream bank erosion, impervious surfaces themselves can also increase thermal pollution of a stream. While natural soil and vegetative cover moderate the temperature fluctuations of solar radiation, roads, buildings, parking lots, and other impervious surfaces do not and thus increase the temperature extremes since they return their heat more rapidly. This phenomenon also increased the rapidity and amount of runoff from melting snow and ice which occurs more gradually under vegetative cover and on natural soils.

In addition to the many problems with water quality produced by increased sedimentation from development in the watershed, chemical and organic pollution is also a harmful result of poorly regulated land use. Impervious surfaces not only accelerate the amount of runoff, they also produe polluted runoff. Parking lots, streets, and airports can add petroleum products to runoff water, as well as significant amounts of salts and chemicals used to melt ice and snow. Storage areas for fertilizers and chemicals raise the dangers of spills and leaks, and dumping and landfill sites can contribute even further to polluted runoff. Sewage plants and septic tanks, if they are improperly constructed or placed in highly permeable soils, can overflow or leak polluted water directly into runoff channels or indirectly through groundwater channels which may feed a small creek. Heavy applications of plant fertilizers may find their way rapidly into streams as precipitation runs off these areas into gutters or storm sewers.

Some of these hazards may be minimized by constructing catch basins and treatment facilities for polluted runoff. This or some similar technique is necessary to compensate for the added pollution and the lowered filtering and purifying capacity of the watershed. In a natural condition, the soils and organic litter, wetlands, and the flow of streams act to filter the runoff that passes through them. Removal of vegetation, loss of soils through erosion, destruction of wetlands, and increase in impervious surfaces, and alteration of stream flow can impair this natural method of purifying runoff. Impervious surfaces are particularly hazardous since they not only increase the amount and rate of polluted runoff, they also bypass the natural filters of the soil. Of course it should not be assumed that the watershed's filtering system is capable of purifying all types or vast quantities of runoff pollution. It is not. But it can purify some runoff pollutants and, if it is maintained in a healthy state and care is taken not to exceed its assimilative capacity, the watershed and its various filters can significantly moderate pollution from some carefully planned developments.

If a community wants to preserve the purity and health of its streams and creeks, it must plan and regulate the development of watersheds in order to control the rate and amount of runoff, chemical and biological pollution, and erosion and sedimentation. Crucial to these goals will be the preservation of the filtering and moderating effects of soils, vegetation, and wetlands on runoff. Allowing the construction of too many roads, parking lots, and other impervious services will not only interfere with the watershed's natural filtering processes, but also will increase the amount of runoff and erosion. Finally, the use of agricultural and garden fertilizers and the location and construction of storage and landfill sites and sewage disposal systems must also be regulated.[5]

3. Effects Upon General Natural Systems

As integral parts of the hydrologic and nutrient cycles, streams are crucial resources not only for people, but also for other forms of life and the various ecological communities. Valleys and plains depend upon streams for transportation of water and nutrients; marshes depend upon streams for similar resources; and many species of food and game fish and other wildlife depend upon streams for breeding, maturing, watering, and feeding areas. Thus the ways streams serve the public good in providing given quantities of clean water is reflected in their benefits to the general environment.

But the connection between human needs and environmental needs is not always evenly balanced. For instance, a community may decide to dam its stream as a flood control measure. The impacts of the dam can be far reaching. Wetland areas below the dam may dry up and vegetation along the streams banks will change with lessened flow. Lower flood stages may protect houses built in the flood plain, but they will also deprive the flood plain of sediment and nutrient deposition during flooding and also decrease the cleansing effects of flood waters on wetlands and the stream itself. Thus, the stream may become choked with sediment, destroying many habitats for fish and other aquatic life. Lowered stream flow will also affect groundwater levels, causing springs to dry up in some areas. These and other changes resulting from the dam may go unnoticed, but they have far-reaching impacts on the surrounding environment. And, of course, these impacts may later be felt by the community as it loses some of its wetlands and wildlife habitats.

If a community wants to maintain the general health of its environment, it must consider not only the effects of development and alteration of streams upon its water resources, but also upon its environmental resources such as wetlands and aquatic life.

C. Local Regulation of Streams and Creeks

The regulatory activities for streams and creeks can be divided into site-specific and non-site-specific regulations. Site-specific regulations control the land use within the stream corridor and on the land immediately adjacent to it. But as the previous section points out, effective regulatory action must include regulation of land use in the larger watershed. Erosion control ordinances are the most common form of these controls that extend beyond the immediate site of the stream. These watershed controls are discussed later in this section.

1. Site Specific Regulation

Streams and creeks are sensitive areas. Developmental activity within and adjacent to the watercourse has profound effects on stream hydrology, channel geometry, and water quality. In recognitition of these negative potentials, local agencies have responded with a variety of land-use controls. The simplest and most direct are stream protection ordinances and related regulations. These controls focus on the establishment of buffer areas extending from the bank to a point landward, with a typical range of 50 to 150 feet. Within this zone the objective is to retain the area in its natural condition in order to buffer the effects of development. Consequently, severe restrictions are placed on watercourses alteration through dredging, filling, and excavation prohibitions, and permitted uses within the buffer zone are restricted to those with no danger of topographical disturbance or biochemical pollution.

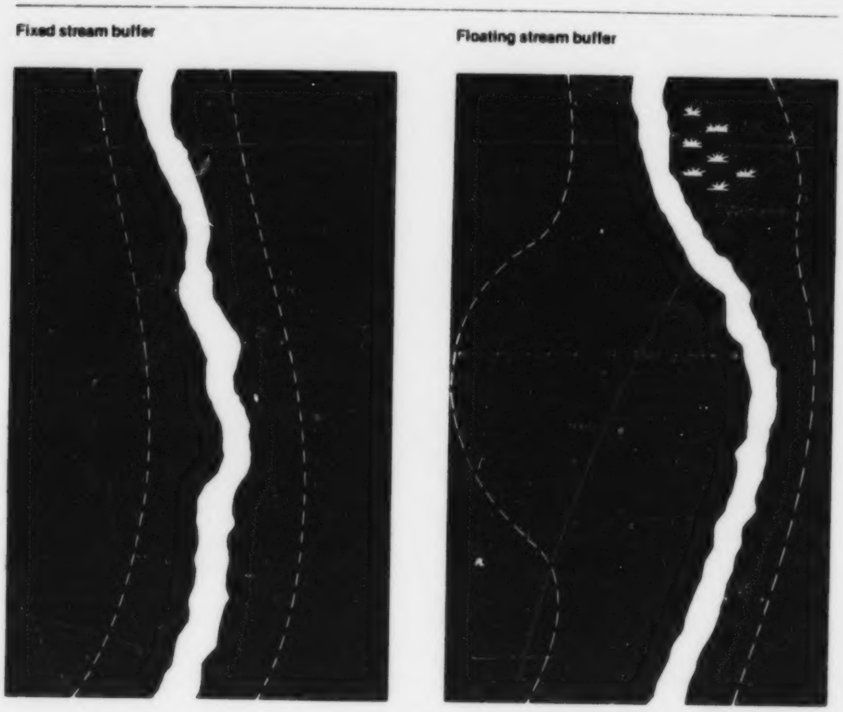
The passage of state shoreline protection acts has fostered varied local regulatory approaches on a more comprehensive scale. In these cases, the buffer area is generally increased to a range of 150 to 200 feet. Furthermore, the acts tend to specify an even larger shoreland planning area in which special shoreline regulations are applied. As a result, these programs tend to cover the impact of more uses over a broader geographical area.

a. Defining The Buffer Zone--A buffer zone is simply an area extending from the banks or high water mark of the stream to some point landward. This zone serves two functions: it protects adjacent developments from the stream and it protects the stream from the adjacent developments. In the first instance, the buffer is simply a margin of safety. Natural processes and man-induced changes often alter stream hydrology by increasing peak flows, which in turn change stream channel geometry. Radical changes in stream channel geometry often result in flood and erosion hazards to adjacent populations.

The second function of the buffer is less obvious. Protecting the stream from development requires that the negative influence of increased runoff, sedimentation, biochemical degradation, and thermal pollution be minimized. Since the ordinance usually states that some portion of the buffer zone is to be retained in its natural state, the preserved vegetation adjacent to streams reduces the force of runoff, which in turn decreases potential sediment loads. The shade from vegetation also lessens thermal pollution associated with runoff from impervious surfaces, and leaves and litter trap harmful biological pollutants. Thus, a buffer of vegetation is a final filter to the sediment and pollution produced by urbanization.

There are two principal ways of defining the buffer boundary. The boundary may be a fixed distance from the banks or high water point of the stream, or the boundary floats or is adjusted according to the character of the adjacent lands. Sensitive areas such as hillsides or wetlands may have deeper boundaries than other areas. (See Figure IV-5.)

Figure IV-5



Fixed-point boundaries extend from as little as 25 feet from the bank to as much as 300 feet. Napa County, California, defines a 50-foot buffer zone on either side of the watercourse. In Orange County, New York, the zone is 200 feet. In the Oakland County, Michigan, Model Ordinance, a buffer of 25 feet is recommended; while the towns of Marlborough and Brooklyn, Connecticut, have established a buffer of some 150 feet. As should be apparent, there is a great deal of variation in the definition of the fixed point boundary. Important considerations in the local definition are the existing character of the stream, the character of adjacent developments, and to some extent the existence of specific state enabling legislation.

The main advantage of the fixed-point buffer is the ease with which it is administered. It is relatively simple to determine whether a projected development will fall within the buffer or not. The key weakness is found in the rigidity of fixed boundaries. Since streams are often associated with other important resource areas such as hillsides, wooded areas, and wetlands, fixed-point boundaries may exclude consideration of these related sensitive areas. For instance, if the boundary extends to 25 feet of high-water elevation and if the wetland is located 26 feet away from that point, then the fixed boundary gives no protection to it or similarly located resources. In this eventuality, unregulated development in the resource outside the buffer may harm the quality of the stream.

A floating buffer varies in width according to the location of other resource areas. This would include, for example, consideration of adjacent sloping areas, poorly drained soils, woodlands, wetlands, and areas with high water tables. Placer County, California, defines its Stream Environment Zone on such a basis:

> A land strip on each side of the stream bed necessary to maintain existing water quality. The width of the stream environment zone shall be determined by investigation. Investigation shall consider;
>
> (1) Soil type and how surface water filters into the ground;

(2) Types and amount of vegetative cover and how it stabilizes the soils;

(3) Slope of the land within the zone and how significant it is for retaining sediment from reaching the streams.

The intent of maintaining the Stream Environment Zone shall be to preserve the natural environment qualities and function of the land to purify water before it reaches the streams.

While the floating-buffer approach assures regulatory sensitivity to critical areas along the stream, its weakness lies in investigation and evaluation of such areas. Under a fixed-boundary system development is either prohibited or not, depending upon whether it falls in the buffer area. Under the floating method development may or may not be allowed depending upon how the buffer is defined, and that will depend on the thoroughness of the evaluative process.

Local communities with limited staff resources should consider a combination of fixed and floating boundaries. Under this combination, the regulations would define a fixed boundary which could be adjusted depending upon the location of related resource areas. If a proposed development abutted on the fixed boundary, the ordinance would require the submission of environmental information about other resources within the parcel. If critical areas were present in the area, the boundary would be extended to include these resources or special regulations could apply. If not, the boundary would remain fixed and development could proceed. In this way, the boundary could be adjusted according to the location of other critical areas.

Still another alternative is to define the fixed-buffer area very liberally, perhaps to 300 feet on either side of the stream. Permitted uses within this zone could be keyed to the occurrence of critical areas. Thus, a wider range of uses would be permitted in those parts of the zones with no sensitive areas, such as hillsides or woodlands; but where those did occur, a more restricted list of uses would be permitted. Under this alternative or the combination of fixed and floating-buffer zones, a local government will have the administrative advantage of a fixed zone and the flexibility to include related resource areas.

One problem with defining the extent of a buffer zone is the lack of precise scientific formulas that make it possible to determine the optimum buffer width for any single stream. As a result current practice varies extensively and seems to reflect consensus opinion and precedent more than anything else. For example, a decision to define a buffer zone as 25 or 50 feet is based more on observation, the opinion of local experts, and political consensus, than on any scientifically derived formula.

There is opportunity, however, to evolve more precise formulas. If, for example, it is possible to identify the exact trapping function of the buffer in terms of runoff, sediment, and biopollutants, then it would be possible to predict the necessary buffer width to trap the anticipated amount of pollution and runoff. Since it is possible to estimate runoff from any single parcel, the optimum width of stream buffers may thus be more precisely determined. Yet, even if such a formula is discovered, the basic decision remains political. The only difference is that precise data could be enlisted to argue for an effective buffer zone. Since there is little disagreement among scientists concerning the functions of a buffer, the question is one of precise returns from any single choice. However, additional research in this area would be most useful. In the interim, local agencies must rely upon the experience of other communities and local experts.

b. Permitted Uses Within the Buffer Zone--A second part of stream protection ordinances is the identification of permitted uses within the buffer zone. Typically, permitted uses include conservation, recreation, and perhaps agriculture. Uses which involve disturbances of the soil, vegetation, or stream banks or pose the threat of chemical or biological pollution of the stream are prohibited.

Since the objective of restricting land use in the buffer zone is to retain the functions of the area adjacent to the stream, communities must exercise some care in defining permitted uses. For instance, many areas allow agriculture in the buffer zone, even though it may be every bit as detrimental to the stream as rearrangement of its banks or dredging the bed. Farm roads and plowing can disturb the soil cover and produce erosion, and cultivation of soil close to stream banks increases soil permeability and the possibility of bank erosion. Moreover, agricultural fertilizers and pesticides raise the threat of water pollution. Thus, it is questionable whether agriculture is a non-threatening land use in the buffer zone.

The list of permitted uses can expand as the distance from the stream increases. For example, a buffer zone of 25 feet would have a narrow range of permitted uses, but a zone of 150 feet may have a wider range of possible uses. In the latter case the ordinance might rigidly restrict land use within 25 feet of the stream, but allow other activities within the remaining 125 feet of it. In any event, the list of permitted uses is designed to assure that the land immediately adjacent to the stream remain in a natural state and that no nuisance-like uses are permitted in the rest of the buffer zone.

c. Topographical Alterations Within the Buffer Zone--The third feature of stream protection ordinances is closely related to the definition of permitted uses within the buffer zone. It involves strict restrictions on the alteration of the stream and changes in adjacent topography, such as dredging, filling, and dumping in the stream or its buffer zone. Unless the existing condition of the stream presents a safety threat to the community, no alteration should occur which may lead to disturbance of stream hydrology or stream channel geometry.

Many communities, such as Napa County, California, require special permits in order to:

(1) Deposit or remove any material within a watercourse

(2) Excavate within a watercourse

(3) Plant or remove any vegetation within a watercourse

(4) Construct, alter or remove any structure within, upon or across a watercourse

(5) Alter any embankment within a watercourse

Oakland County, Michigan's Model Watercourse and Wetlands Protection ordinance requires a permit if the applicant wants to:

> Deposit or permit to be deposited any material, including structures, into, within or upon any watercourse or wetland area, or within 25 feet of the edge of any watercourse, designated on the. . . .
>
> Remove or permit to be removed any material from any watercourse or wetland area, or from any area within 25 feet of any watercourse, designated on the Official Maps. . . .

The Austin, Texas, ordinance also required a permit for similar activities

> No development, except development which has an inconsequential effect on the environment and on drainage and which has been exempted by the director or engineering, shall be undertaken on any land, tract, parcel, or lot which is adjacent to or crossed by a waterway until a permit for said development has been obtained. . . .

In the ordinance, development is defined as:

> (1) The commencement of mining, excavation, or dredging;
>
> (2) The clearing or removal of natural ground cover and/or trees in connection with site preparation for construction, immediate or future;
>
> (3) The deposit of refuse, solid or liquid waste, or fill;
>
> (4) The alteration or improvement of a bed, bank, or flood plain of a waterway;
>
> (5) The departure from the provisions of a development permit.

Restrictions on topographical disturbance both within and adjacent to the stream are clearly desirable. Since the effect of disturbance is both immediate and direct, local agencies would do well to require a special permit prior to any developmental activity. The permit, in turn, should require a determination on the part of local officials that the proposed actiity will not harm the stream. For instance, the Streambelt Protection Regulation of Marlborough, Connecticut, provides that,

> Any building or construction (including septic systems) within 150 feet of a stream or its accompanying wetlands . . . is permitted only as a Special Exception of the Zoning Board of Appeals. It shall be proven by the developer that building or construction within the streambelt will not cause pollution or impair the health or safety of the residents, or the ecological balance of the area.

This provision is a common feature of wetland ordinances where the applicant is required to show that the proposed activitiy is compatible with the health of the wetland resource.

Buffer zones, lists of permitted uses, and strict control of topograpical and stream alteration are the important elements of stream protection ordinances. Together they establish a sensible regulatory approach. But in order for stream protection ordinances to be effective, they must be supplemented by non-site-specific regulation of watershed development provided under erosion-control ordinances.

d. Jurisdictional Considerations of Stream Protection--A common criticism of regulations affecting small watercourses is that the stream extends beyond the limits of the local jurisdiction. While this is often the case, there are many small streams or large portions of them which are contained within a single jurisdiction.

When only small segments of the stream are within a locality's jurisdiction, some regional or integrative approach must be found. Councils of governments, regional planning agencies, and regional soil conservation offices can play a role in effecting coordinated, environmentally sensitive local regulation of streams.

County governments offer another answer to the problems of jurisdictional boundaries. Counties with the power to regulate land use can develop and administer such regulations. With or without land-use powers, counties can take on a stronger coordinating function with local governments. For instance, the County Board of Supervisors of Fairfax County, Virginia, established a "County Stream Valley Board" whose function is to coordinate land use as well as open space and other recreational programs. Composed of members of the Regional Soil and Water Conservation District, the County Park Authority, and various members of the county staff, the board is the primary coordinating agency for the management of the stream valleys. Similarly, the Santiago Creek/Santa Ana River Greenbelt Program in Orange County, California, has a coordinating purpose. Both the County and the cities within the county adjoining the stream and river are active in the greenbelt program. As with Fairfax, Orange County emphasizes coordinated open space decisions and the consistent application of land-use controls in local communities.

Still another potential source of integrative action are the many Regional Water Quality Boards which are primarily concerned with water policy. Thus, their role in coordinating or administrating stream protection or shoreline management controls is an appropriate one.

In coordinating land-use controls for streams, it is important to note that they need not necessarily be uniform in substance or application.

It is far more important that some form of control, however uniform it is, be established. At this stage in the evolution of land-use controls for sensitive areas, most local jurisdictions do not have special ordinances for streams. Consequently, the first duty of the integrative agency is to get agreement on the concept of control and its key elements. Decisions as to a buffer 50 feet, 100 feet, or 200 feet can come much later.

e. State-Mandated Stream Protection--Several states have comprehensive water resource acts which not only encourage communities to develop stream protection ordinances, but also serve as the basis for coordinated effort among various jurisdictions. These state-mandated stream protection provisions usually extend the common width of the buffer and the designated planning area, thus beefing up already existing, but narrowly defined buffer zones and planning areas on the local level. Wisconsin and Washington are two good examples of this new trend in stream protection.

(1) Wisconsin - 1965 State Water Resources Act

Wisconsin's State Water Resources Act of 1965 requires local agencies to develop and adopt regulatory programs for the protection of shorelands as well as flood plains. As defined under the Act, shorelands include not only lakes and ponds, but also navigable and non-navigable streams. The shoreland extends "three hundred feet from the high water elevation of navigable streams or to the landward side of the flood plain, whichever is greater." Navigable streams are those designated by the USGS as perennial--a stream which contains water most of the year except for infrequent and extended periods of drought.

One important aspect of the definition is the relationship to the flood plain. Since many local jurisdictions have adopted flood plain regulations, it is useful to consider the regulatory relationship between the two in terms of boundary definition. In the Wisconsin case potential boundary confusion is settled by defining the limits of the shoreland as "three hundred feet from the high water elevation of navigable streams or to the landward side of the flood plain, WHICHEVER IS GREATER." (authors' emphasis). In other words, 300 feet is the minimum extent of the boundary. However, if the flood plain extends to 500 feet, then the planning area would also extend 500 feet from the stream. In order to eliminate regulatory overlap and possible inconsistencies, it is useful to qualify the flood plain and shoreland regulation as the Wisconsin law does by stating that the more inclusive definition of the two applies. In most cases, this means that the flood plain regulation would be most commonly applied.

Another aspect of the relationship between flood plain and stream protection is the different purposes of each. Flood plain regulations focus on the protection of people and structures from flood hazards. On the other hand, stream protection or shoreland regulations emphasize flood and erosion hazards and water quality considerations. Since a sole emphasis on flood hazards is not sufficient to protect water or prevent erosion or sedimentation, the addition of shoreland or stream protection rounds out the regulatory approach.

Within the shoreland planning area, Wisconsin's law defines a buffer zone, which tends to be larger than those of most local stream protection regulations in states with no state mandate. For perennial streams, the buffer is roughly 100 feet landward from high water elevation. In the buffer zone, which, of course, includes the stream itself, topographical alterations are restricted. Through the use of setbacks and restrictions on clearing natural vegetation, development activity is kept to a minimum in this area. Regulations also contain restrictive standards for septic systems, which must be set back at least 100 feet from streams. Moreover, they are prohibited in steep slope areas, wet soils, and areas with outcroppings of bedrock. Since, as with all buffer zones, the objective here is to retain the area in its natural state, only nonintensive uses are allowed and topographical alterations are strictly controlled.

(2) Washington - Shoreline Management Act of 1971

In 1971, the State of Washington passed the Shoreline Management Act. Like Wisconsin's law, the Act covers streams and other water resource areas. As defined in the Act, any stream which has a mean annual flow of more than 20 cubic feet per second is covered. In such streams the shoreland planning area extends 200 feet landward from the ordinary high water mark. Stream shorelands are generally divided into five basic districts--urban, suburban, rural, conservancy, and natural. The designation of the appropriate district depends upon two principal considerations: the existing and expected character of development and the character of the natural features in the area. In this way both man-made and natural criteria are utilized in the choice of district designation.

Washington's Act specifies that local jurisdictions, cities and counties, are required to develop plans and regulations to implement its provisions. For each district the state law establishes a set of management policies which serve as elementary guidelines for the preservation of the stream. In the urban district, for example, the management policies allow the greatest extent of development possibilities. As one moves from the urban district to the suburban, rural, conservancy, and natural ones, the general management policies become more restrictive. Fewer and fewer development objectives are available as the emphasis turns to environmental objectives.

In addition to general management policies for any one district, the state guidelines also specify permitted uses for each district and a special set of standards for regulating them. In the urban district, the number of permitted uses is quite large and the standards are permissive. In natural districts the permitted uses are most restricted and the evaluative policies and standards are quite stringent for any of the possible uses.

An example of a local application of the Washington law is Snohomish County's "Shoreline Management Master Program." As specified in the state legislation, the program was developed by a citizens advisory group in conjunction with the county planning staff. Snohomish followed the specific state guidelines and also added some innovative approaches of their own. As they followed the state mandate, the citizens group and staff developed the elements of the Master Program, designated the environment districts, established policies and permitted uses, and proposed a development evaluation process for the shoreline area. (See the appendices of this chapter for a step-by-step discussion of the Snohomish evaluation process.)

The Snohomish method of regulation is a combination of policy evaluations and specific standards. Each permitted use must conform to general shoreline policies, use policies in the specific environment district, use activity policies, use activity general regulations, and use activity regulations specific to the environment. The regulatory process moves through these policies and regulations from the general evaluations to site-specific considerations for each applicant. At each evaluative step the program allows for both conditional uses and variances. In addition, a permit for a specific use may be denied on the basis of either policy evaluation or standards evaluation. Thus, in themselves, policies can be the basis for decision.

Another important feature of the Snohomish approach is the possible combinations of regulations and policies which might apply to any applicant. For example, an applicant for a Planned Unit Development might have to comply with the relevant requirements for residential, commercial, and utility uses for one or perhaps two environment districts. Thus, this regulatory approach provides a broad evaluative framework for any development proposal.

Although Snohomish represents one of the more comprehensive regulatory approaches to stream resource protection, the specifics of the Snohomish method will not be appropriate for all jurisdictions. Since environmental factors vary from place to place, permitted uses will also vary. And since the character of existing developments might be quite different in other areas, the specific aspects of the process can also change. Moreover, smaller jurisdictions may not have the evaluative expertise available to Snohomish.

Even though the exact Snohomish approach may not be appropriate for all areas, its basic features are attractive:

1. The designation of districts with specific permitted uses makes good environmental, economic, and legal sense.

2. The establishment of general and specific policies and regulations allows for flexibility in the application of land-use controls.

3. Further, the combination of evaluative policies and specific regulations provides a good combination of standards to insure minimum protection and performance and flexible policies to allow for the evaluation of factors not easily specified.

4. Finally, each application is reviewed on the basis of all potential uses, not solely on its stated, primary use.

Taken as a whole, the Snohomish approach is a good one and provides a helpful model for other areas.

2. Non-Site Specific Regulation

Site-specific regulations, such as Stream Protection Ordinances and state-mandated Shoreland Protection Acts, focus on the control of land use within and immediately adjacent to streams. On the other hand, non-site-specific regulations, such as runoff, erosion and sedimentation control ordinances, focus on land-use regulation in the entire watershed. Neither type of regulation is sufficient in itself. Site-specific regulations afford protection to stream banks and prohibit potentially damaging development activities on land adjacent to streams. These regulations do not, however, protect the stream from the harmful effects of increased runoff or sedimentation as a result of development in the watershed. Non-site-specific regulations are designed to provide protection from developmental impacts in watershed areas outside the streamside buffer strip. Together both types of regulations provide more complete protection for surface water resources and the many related sensitive areas, such as wetlands, groundwater recharge areas, and hillsides.

The two types of non-site specific regulation of the watershed--Runoff Control Ordinances and Erosion and Sedimentation Control Ordinances--are clearly related. Since the natural processes of runoff, erosion, and sedimentation are intricately connected to the amount of precipitation, the amount of vegetative cover, the type of soil, the degree of slope, and the length of slope, an ordinance which controls runoff will minimize erosion and sedimentation, and vice versa. However, it is important to note the substantive differences between erosion-sedimentation controls and runoff controls. The key difference is the time over which the controls are applied. Erosion and sedimentation controls are principally concerned with regulating the process of construction, while runoff controls are intended to regulate the effects of development both during and following construction. Runoff control emphasizes drainage over the long term, while erosion and sedimentation regulations emphasize the control of soil disturbance during and immediately following the period of construction.

One further difference is in the objective of the ordinance or regulation. Runoff, until recently, had flood control as the principal objective. On the other hand, erosion and sedimentation controls have the multiple objectives of protecting water and soil quality, as well as flood control. Since the two ordinance types are not equivalent, local agencies must consider relevant features of both in order to form an effective coordinated regulatory package.

a. Runoff Control Ordinances--Early methods of controlling runoff in a watershed were directed primarily toward flood control and utilized techniques such as channelization, levees, dams, and other alterations of the natural drainage pattern of the watershed. While flooding from excessive runoff was thus brought under control, ditches and similar construction created new environmental problems. And since the purpose was to provide adequate drainage for the increased runoff from impervious surfaces, more development meant even more drainage construction.

Recently, some local areas have moved toward a very different approach to the control of runoff. Under the concept of environmental performance standards, this new approach requires that the amount of runoff from any specific development will not exceed the carrying capacity of the natural drainage system. In this way the natural drainage system continues to perform its function to adequately drain a watershed. Moreover, the great expense of constructing a new, artificial drainage system covering the entire watershed is minimized.

In communities developing such onsite runoff controls, the essential regulatory theme is simple. Runoff from any specific development must not be greater than would be the case under natural conditions. With the advanced work of the U.S. Soil Conservation Service, it is possible to estimate the runoff from any specific site under natural conditions. (See the discussion of Environmental Performance Standards at the end of this manual for details of these procedures.) Using this information, the local agency is able to establish exact standards of performance for any specific area subject to development.

In addition, the developer is free to use a variety of methods to assure that runoff from his development does not exceed the natural, specified limit. For instance, a developer may retain a certain percentage of his land in vegetative cover, or he might construct parking lots and roads out of pervious materials, or he might construct retention facilities for runoff. The authors of a recently issued report entitled Water Resources Protection Measures in Land Development, A Handbook, identify some 12 major types of measures to control increases in runoff due to development, ranging from roof retention to porous pavement.[6] Instead of specifying particular methods, runoff control ordinances based on the performance standard approach leave that decision to the developer as long as whatever method he chooses meets the required standard.

In DeKalb County, Georgia, a proposed environmental ordinance establishing regulations for soils, topography, vegetation, and drainage uses the performance standard approach in the control of runoff. The ordinance covers "All persons proposing development or construction on property located in DeKalb County. . . ." In the section dealing with runoff, the ordinance provides that,

> The release rate of storm water from all developments shall not exceed the storm water runoff from the area in its natural state for all intensities and durations of rainfall. The carrying capacity of the channels immediately downstream must be considered in determining the amount of the release. The County will accept a release rate not greater than that calculated from a storm of two (2) year frequency with a runoff rate coefficient of 0.20, 0.25, and 0.35 for land with an average slope of up to 2 per cent, 2-7 per cent, and over 7 per cent respectively.

The ordinance also specifies required capacities for runoff-retention facilities:

> The live retention storage to be provided shall be calculated on the basis of the 100-year frequency rainfall as published by the National Weather Service for the affected area. The retention volume required shall be that necessary to handle the runoff of a 100-year rainfall, for any and all durations, from the proposed development less that volume discharged during the same duration at the approved release rate as specified above.

Much the same approach has been developed in Leon County, Florida, where an ordinance relating to the control of onsite-generated erosion, sedimentation, and runoff provides that

> The plans to be implemented by such person for controlling on-site generated sedimentation, erosion, and runoff, said plans to be designed to control runoff, to prevent damage to downstream property owners, and to remove sediment prior to discharge of peak storm runoff from storms having a recurrence frequency of 25 years. Rainfall-intensity curves as developed by the Florida Department of Transportation shall be the basis of design. . . .

Once again, the emphasis on the control of runoff occurs at the site.

In such approaches, the costs of the negative impacts of the development are internalized at the site of development rather than spread over the entire watershed. A recent study in Illinois shows that onsite detention of stormwater not only prevents additional runoff from flooding downstream areas, but that it is frequently cheaper than the alternative of constructing storm sewers.[7] At Bloomingdale, Illinois, for example, the choice of such a storage system saved $370,000 over the estimated costs of constructing an adequate storm sewer. The performance standard approach to the control of runoff is a good one. Since flood hazards and environmental threats originate at specific development sites, it is appropriate that they be controlled at the site. Moreover, the cost for environmental protection falls on the proponent of the development rather than the community at large which would otherwise bear the costs of elaborate, costly, and frequently environmentally unsound flood-control schemes. Natural drainage systems are left to perform their natural functions.

b. Erosion and Sedimentation Control Ordinances[8]--Erosion and sedimentation control ordinances function to sensitize development to the erosion/sedimentation potential of the site. Rarely do these ordinances establish uniform specification for all development. Rather, each development application is evaluated on the basis of various site characteristics such as type of soils, degree/length of slope, size and duration of exposed surface. Thus, development in sloping, easily eroded soils would be required to meet more exacting standards than equivalent development in flat terrain with less erodible soils.

Most sedimentation-erosion controls are included in local land-use regulations either by establishing a separate ordinance or amending the basic zoning and subdivision ordinances. In choosing one approach or the other, the local agency should consider relevant state enabling legislation, the effectiveness and efficiency of administering the ordinance, and the capabilities of the evaluative body. If the state has specific erosion/sedimentation enabling legislation, such as New Jersey, local agencies would choose a separate ordinance as provided by the state mandate. If not, they would amend the zoning or subdivision ordinance which will have broader, more established police powers than a new, separate ordinance. Moreover, a separate ordinance could be more difficult to administer than one attached to already existing zoning or subdivision ordinances. Yet if the sedimentation-erosion control is attached to zoning or subdivision regulations, it might fall under the review of a decision-making body not qualified to evaluate these considerations. In this case, a separate ordinance which requires review by the local soil conservation district might make more sense. Regardless of the path chosen, the substance of the sedimentation/erosion control ordinance remains much the same.

Key features of the regulation are 1) requirements for an erosion/sedimentation control plan; 2) data requirements for the plan; 3) review and approval; 4) evaluative principles. The requirements for a plan simply specify that no land area shall be disturbed, until a plan for soil erosion and sedimentation control has been submitted to and approved by the relevant agency. The agency or individual might be the planning department, the soil district, the building inspector, city engineer, planning commission, or perhaps the town council.

Data requirements for the plan include: 1) location and description of existing topographical features and soil characteristics of the site, such as length and degree of slope, type of soil, type and amount of vegetation cover; 2) location and description of proposed changes to the site; 3) measures for soil erosion and sediment control (may be tied to standards established in a separate publication); 4) a scheduling sequence for the installation of control measures for each stage of the project, along with starting and completion dates for each phase; and 5) a catch-all requirement for any special data (such as impact on adjacent sensitive areas) the review agency deems necessary for the development of a specific site.

Evaluative principles follow a general format, such as the following from an Erosion/Sedimentation Control Ordinance in Camden, New Jersey:

Article VI--Standards of Performance

6.1 Design Standards: The applicant or landowner shall conform to the published Standards for Soil Erosion and Sediment Control in New Jersey as issued by the New Jersey State Soil Conservation Committee.

Copies of these standards are and shall be maintained available for reference at the office of the District Secretary, 152 Ohio Avenue, Clementon, New Jersey 08021.

6.2 General Principles for Performance: Performance shall include, but not be limited to, conformance to the practices enumerated below. (Parenthetical numbers refer to section or page numbers in the 14 June, 1972 issue of the Standards referenced in Article 6.1 above).

6.2.1 The smallest practical area of land shall be exposed at any one time during development.

6.2.2 When land is exposed during development, the exposure shall be kept to the shortest practicable period of time.

6.2.3 Natural features such as trees, groves, natural terrain, waterways and other similar resources shall be preserved wherever possible in the process of developing plans for development and use of lands.

6.2.4 The boundaries and alignment of streams shall be preserved and shall conform substantially with the natural boundaries and alignment of such streams.

6.2.5 Temporary vegetation and/or mulching shall be used to protect critical areas exposed during development. (Standards 3.11 and 3.31).

6.2.6 The permanent final vegetation and structures shall be installed as soon as practical in the development. (Standards 3.21 and 3.41).

6.2.7 Wherever feasible, natural vegetation shall be retained and protected. (Standard 3.61).

6.2.8 No top soil shall be removed from the areas except those intended for structures or to be covered by man-made improvements. The top soil from areas intended for such improvements shall be redistributed within the boundaries of the lands in questions so as to provide a suitable base for seeding and planting. (Standard 3.51).

6.2.9 The development shall be fitted to the topography and soils to create the least erosion potential. (Standards 4.11 and 4.51).

6.2.10 Provisions shall be made to effectively accomodate the increased runoff caused by changed soil and surface conditions during and after development. (Standards 4.21, 4.31 and 4.61).

6.2.11 Sediment basin (Debris basins, desilting basins or silt traps) shall be installed and maintained to remove sediment from runoff waters from land undergoing development. (Standards 4.41).

Finally, the regulation may require performance bonds to insure the installation and maintenance of the control measures for some minimum period ranging from one month to one year following the end of construction.

Since the effectiveness of the ordinance or regulation depends upon the judgement of the review body, it is apparent that additional evaluative resources are required, such as a competent planning staff with some training in the soil sciences and conservation practices, or a joint evaluative arrangement with the Soil Conservation District. If the joint arrangement is inappropriate, a planning staff with little soil science background might consider the use of the numerous publications on standards for erosion and sediment control. In these publications, some of which are listed in the bibliography to this section, a local or state soil conservation agency lists and evaluates general guidelines and a series of control measures ranging from vegetative standards for erosion control to design standards for various engineering devices, such as diversions, grassways, sediment basins, and other structural or chemical-control devices. In these handbooks, the standards are quite exact and the evaluative methods are relatively simple to understand. Consequently, for the local planning agency with primary evaluative responsibility, these publications are quite useful. They serve to round out general evaluative standards and provide developers with a more exact description of their expected performance.

The role of various soil and water conservation and natural resource districts in the local regulation of erosion and sedimentation has been a key one. Currently there are some 3,027 of these districts in all 50 states. Together these jurisdictions cover over 98 per cent of the privately owned land in the nation. These districts are legal subdivisions of each state and are governed by 5-7 persons elected or appointed in accordance with the particular state law. While they provide various services to local jurisdictions, the primary emphasis has been on the control of erosion and sedimentation.

In the late 1960s, many of the districts began entering into joint agreements with local governments concerning soil and water management in the development process. In line with their changing emphasis from agricultural soils to problems of urbanization, the districts began developing guidelines for the control of erosion and sedimentation in the development process. In addition to the guidelines, numerous districts established agreements with local jurisdictions for the purpose of evaluating soil and erosion problems in particular development applications. Under these agreements, each application for development is required to have an erosion and sedimentation control plan in line with the standards established by the district. The district then evaluates the control plan and, in some cases, serves as the enforcing agent. By 1972, under such agreements the districts were providing services to some 2,000 communities and had entered into more than 2,000 cooperative watershed and flood protection projects. Clearly, soil water conservation districts have been among the prime movers in the control of erosion and sedimentation in the development process. Given this central role of such conservation districts, local communities are well advised to solicit the participation of the local soil district. With their special history and expert resources, they are generally well prepared to participate in such a regulatory program.

In spite of the enormous contribution of soil conservation districts, many local agencies are still without erosion and sedimentation controls. Even if the controls are on the books, there is a problem in the application of the controls. In many areas, the regulations are so generally stated and the evaluative resources so weak that the provisions of an erosion and sedimentation-control ordinance are essentially meaningless. However, with the aid of the publications currently available and the participation of local soil districts, there can be effective regulatory programs. In a continuing flow of studies of the effectiveness of various control devices, it is clear that the environmental return from such land controls are substantial.[9]

NOTES

1. Joachim Tourbier, Water Resources as a Basis for Comprehensive Planning and Development of the Christina River Basin, (Newark, Del.: University of Delaware Water Resources Center, 1973), p. 6.

2. For a more detailed discussion of streams and creeks and their role in the hydrological cycle, see
Luna B. Leopold and Water B. Langbein, A Primer on Water, (Washington, D.C.: U.S. Government Printing Office, 1960).

3. Paul W. Mckee, Problems of the Potomac Estuary, (Washington, D.C.: Interstate Commission on the Potomac River Basin, 1964), pp. 40-46.

4. Tourbier, p. 6.

5. For further reading on sedimentation see the following:
Thomas R. Detwyler and Melvin G. Marcus, Urbanization and the Environment, (Belmont, California: Duxbury Press, 1972), pp. 103-108;
Luna B. Leopold, Hydrology for Urban Land Planning: A Guidebook on the Hydrologic Effects of Urban Land Use, USGS Circular 554, (Washington, D.C.: U.S. Government Printing Office, 1968).

6. Joachim Tourbier and Richard Westmacott, Water Resources Protection Measures in Land Development: A Handbook, (Newark, Delaware: University of Delaware Water Resources Center, 1974).

7. U.S. Department of the Interior, Office of Water Resources Research, Annual Report 1973, refer to Illinois project C-3380.

8. This section complements a great deal of the material in Appendix A. Appendix A is concerned with the concept of Environmental Performance Standards as a regulatory device in the control of runoff and erosion.

9. L.D. Meyer, C.B. Johnson and G.R. Foster, "Stone and Woodchip Mulches for Erosion Control on Construction Sites," Journal of Soil and Water Conservation, Nov.-Dec. 1972, p. 264;
Joachim Tourbier, op cit.

BIBLIOGRAPHY

Coughlin, Robert E. and Thomas R. Hammer. Stream Quality Preservation Through Planned Urban Development. Washington, D.C. 1973.

> A report prepared for the Environmental Protection Agency that deals with preventing negative effects of urbanization on streams and creeks through planning. It includes findings on fiscal and nonfiscal benefits of planning, effects of urbanization on stream channel enlargement and water quality, and makes recommendations on development restrictions for stream preservation.

Easterbrook, Don J. Principles of Geomorphology. New York. 1969.

> An excellent basic textbook on gemorphology, the study of the movement of land and land masses of the earth. It includes discussions of erosion, stream and hillside stability and geologic hazards. Well illustrated and concise.

Institute for Environmental Studies, Regional Science Research Institute, and Untied States Geological Survey. The Plan and Program for the Brandywine. Published by Institute for Environmental Studies, University of Pennsylvania, Philadelphia. 1968.

> This is the final report of a consulting group that made a study of a section of the Brandywine River watershed "to determine whether the inevitable urban development of the Upper East Branch watershed can be accomplished with the minimum of damage and disruption to the water, scenic, and other natural resources of the area. . . ." Section II describes the setting, geology, climate, hydrology, etc.; Section III, the plan, discusses land use proposals, erosion controls, and other recommendations. There is a final section on implementation of the program including a discussion of costs.

Langbein, Walter B. and Luna B. Leopold. A Primer on Water. Washington, D.C., U.S. Geological Survey. 1960.

> A well illustrated introduction to the role of water on planet Earth. It begins by explaining the water cycle, how water moves from atmosphere to earth and back to atmosphere and includes sections on ground water and surface water flow. Some of the problems associated with water, flooding, sedimentation, erosion are described also. The second part of the primer is titled, Water Use and Development and discusses the fluctuating nature of the water supply and the problems that may be encountered as

the demand for water increases. This is an excellent resource for those who require a simple but intelligent introduction to all aspects of water resources.

Leopold, Luna B. *Hydrology for Urban Land Planning: A Guidebook on the Hydrologic Effects of Urban Land Use*. Geological Survey Circular, No. 554, Washington, D.C. 1968.

This handbook is a relatively technical document dealing with the application of flood data to planning. Included is a section on planning procedures and hydrologic variables as well as statistics on the effect of urbanization on increasing flooding and sediment production.

New Jersey State Soil Conservation Committee. *Standards for Soil and Sediment Control in New Jersey*. Published by The New Jersey State Soil Conservation Committee. 1972.

An excellent erosion and sediment control handbook. It has sections on vegetative and engineering methods for stabilizing soil. Although developed for New Jersey it is applicable to many other areas.

Regional Science Research Institute. *Environmental Study of the Wissahickon Watershed Within the City of Philadelphia*. Philadelphia, Pennsylvania. June, 1973.

This is a comprehensive report covering all aspects of the effects of urbanization on a watershed in the Philadelphia area. It includes an inventory and description of physical and man-made setting and an analysis of the effects of urbanization on the watershed including all of its tributaries. There are sections on impacts of future development and recommended restrictions that would limit this predicted impact. Water quality, terrestial ecology, and aesthetic impacts are also covered and the report concludes with two sections that deal with reducing impervious coverages. There are lots of data in this report but the analyses and conclusions are readily understood and applicable to other watersheds.

Tourbier, Joachim. *Water Resources as a Basis for Comprehensive Planning and Development of the Christina River Basin*. Water Resources Center, University of Delaware, Newark, Delaware. 1973.

This is a technical report covering the completion of the first phase of a study of the Christina River Basin in northern Delaware. In the study the Basin was used as a model area to analyze techniques for the long-range protection of water quality and water supply in areas undergoing urban development. It describes a natural resource inventory that was made, discusses refinement of the site class concept for protection of water resources and protection measures and their costs. It has a very fine section on groundwater and recommends some innovative methods of protecting groundwater.

DATA NEEDS AND TECHNICAL ASSISTANCE

In considering regulation of a small watershed flooding is the main concern. How often do floods occur? How much land do they cover? How far above the flood stage should development be allowed? The USGS and state geological surveys have worked cooperatively in developing flood inundation maps for many small and large watersheds. With these maps and field help from the survey you could arrive at an adequate buffer recommendation for the stream or creek. The USGS topographic maps, which indicate elevation and contour, are in many libraries, but the flood inundation maps may have to be obtained from the state geological survey. (Probably located where your state land grant college is; if you don't know, call a regional USGS office.)

The USGS has a district office in every state that works cooperatively with the State Geological Survey (only Rhode Island does not have a State Survey or its equivalent). A request for assistance should probably be initiated, however, at the nearest of the nine regional USGS offices, (see Appendix G, page 517), they could tell you where your district office is located and who to talk to. The district office will then refer you to the State Geological Survey office. This three-stage referral seems bothersome, but it is probably worth the effort so that you don't by-pass potential resource people.

The USGS and State Survey hydrologists know about sedimentation; they can help to predict what kinds of changes in bed geometry and stability will take place if sedimentation of a stream occurs from construction. The Soil Conservation Service Soil Survey maps will also be useful in determining the likelihood and degree of sedimentation. This is an important consideration; the soil that leaves uplands will find its way fairly quickly into the stream. Few libraries carry complete sets of soil survey maps, so go directly to your local SCS office if you know its location. If not, call the state conservationist's office to find out. (See Appendix E, page 512).

Technical information of wildlife use of streams is provided by the Fish and Wildlife Service and the state game biologist or game commission. They can tell you if you have rainbow trout in your creek or what kinds of wildlife drink from it. Call the nearest regional office (see Appendix C, page 510) of the USFWS and ask for the Associate Director for Federal Assistance. He/she can tell you the name of state and sometimes local game biologists who can answer your questions.

Many states have Departments of Natural Resources whose concerns range from strip mining to mosquito control. In some states these agencies are beginning to take an interest in maintaining the stability of watersheds and the environment in general. The DNRs would be located in the state capital and would be worth checking with on inquiries about streams and creeks or other natural areas.

On a local level there are often old timers, amateur naturalists, high school biology teachers, and other people who have a substantial amount of knowledge about local natural areas, as well as a substantial amount of enthusiasm. Using these local people helps to develop a grassroots interest in whatever you may be trying to do with a natural area, whether it involves total preservation of a wetland or trying to keep a developer from taking all of the trees down. By combining the services of state, federal and local governmental agencies with local knowledge you can probably get a fairly well-rounded assessment of any natural area.

A SELECTED LIST OF COMMUNITIES WITH STREAMS AND CREEKS REGULATIONS

Austin, Texas
Planning Department
P.O. Box 1088
Austin, Texas 78767

Benton County, Washington
Planning Department
Benton-Franklin Government
Conference
906 Jadwin Avenue
Richland, Washington 99352

Henrico County, Virginia
Planning Commission
21st & Main Streets
P.O. Box 27032
Richmond, Virginia 23261

Kitsap County, Washington
Kitsap County Planning Department
614 Division Street
County Administration Building
Port Orchard, Washington 98366

McHenry County, Illinois
McHenry County Planning Department
Woodstock, Illinois 60098

Marion County, Florida
Marion County Planning Department
P.O. Box 697
Ocala, Florida 32670

Mine Hill, New Jersey
Planning Department
Town Hall
Mine Hill, New Jersey 07801

Monroe County, Michigan
Monroe County Planning Commission
County Court House
Monroe, Michigan 28161

Napa County, California
Conservation Development and
Planning Department
1121 1st Street
Napa, California 94558

Oakland County, Michigan
Oakland County Planning Commission
1200 North Telegraph Road
Pontiac, Michigan 48053

Orange County, California
Planning Commission
400 Civic Center Drive West
Santa Ana, California 92701

Orange County, New York
Department of Planning
The County Building
Goshen, New York 10924

Redmond, Washington
Redmond Planning Department
15670 N.E. 85th Street
Redmond, Washington 98052

Sacramento County, California
Planning Department
827 7th Street
Sacramento, California 95814

Santa Rosa, California
Planning Department
P.O. Box 1678
Santa Rosa, California 95403

Snohomish County, Washingon
Snohomish County Planning Commission
Everett, Washington 98201

Walworth County, Wisconsin
Southeastern Wisconsin Regional
  Planning Commission
County Building
Walworth, Wisconsin 53184

Waukesha, Wisconsin
Waukesha County Park and Planning
  Commission
County Building
Waukesha, Wisconsin 53186

(EXCERPT)

APPENDIX IV-a

ORDINANCE OF THE BOARD OF SUPERVISORS OF THE COUNTY OF NAPA, STATE OF CALIFORNIA, PROVIDING FOR THE CONTROL THROUGH LICENSING OF WORKS CHANGING THE HYDRAULIC CHARACTERISTICS OF CERTAIN WATERCOURSES WITHIN THE COUNTY OF NAPA AND PROTECTING THE RIPARIAN COVER WITHIN SPECIFIED DISTANCES THEREOF; PROVIDING BONDING REQUIREMENTS IN CONNECTION WITH SUCH PERMIT; PROVIDING A FEE SCHEDULE FOR SUCH PERMITS; AND PROVIDING FOR ABATEMENT AS A NUISANCE OF SUCH WORK PERFORMED WITHOUT A PERMIT

Sec. 10200. Findings.

The Board of Supervisors finds that:

(a) Flood hazard areas along certain watercourses in Napa County are subject to periodic inundation which can result in loss of life and property, and can result in health and safety hazards, the disruption of commerce and governmental services, producing extraordinary public expenditure for flood protection and relief, and the impairment of the tax base, all of which adversely affect the public health, safety and general welfare.

(b) These flood losses are caused by: (1) the magnitude of flood flows; (2) the cumulative effect of obstructions in flood plains causing increases in flood heights and velocities; (3) other changes in the hydraulic characteristics of watercourse; and (4) the occupancy of flood hazard areas by uses vulnerable to floods or hazardous to other lands that are inadequately elevated or otherwise protected from flood damage.

(c) The riparian vegetation along these watercourses is a valuable natural resource. A wide variety of plants and ready availability of water provide living conditions for a great number of wildlife species. Many wildlife species, particularly birds, live only in riparian cover.

(d) Flourishing wildlife populations are not the only benefits derived from streamside vegetation. Trees, by shading, help maintain cooler water temperatures and thus retard algae blooms and enhance the fish habitat. Dense tree growth tends to protect stream banks from erosion, thus reducing the need for expensive and historically destructive channelizing projects. Lush strips of trees and ground cover help purify the air and provide an aesthetically pleasing variation to the eye, and in so doing preserve the rural character of the unincorporated area of Napa County

(e) State-wide surveys establish that riparian habitat has suffered greatly under man's expanding development. Thousands of acres have been inundated by reservoirs and stripped for channels, irrigation ditches, agricultural operations, housing tracts and highways. The California Fish and Wildlife Plan predicts an additional 15% loss of this resource by 1980.

Sec. 10201. Purposes.

It is the purpose of this Ordinance to assist in accomplishing the following objectives, thereby promoting the public health, safety and general welfare:

(a) Regulatory objectives related to flood losses:

(1) Protect adjacent, upstream and downstream private and public lands from direct and substantial increased flood damage from:

a. Increased flood heights and velocities due to obstructions placed in watercourses and other alterations to the water conveyance capacity of watercourses.

b. Deposit debris and other materials which are carried by flood waters.

c. Flooding caused by the failure or overtopping of dams, dikes or levees.

(2) Minimize indirect costs to governmental units caused by development work in flood hazard areas which results in:

a. Construction and maintenance of extraordinary and expensive public service facilities for flood hazard areas.

b. Construction of public works such as dams, reservoirs, channel straightening and levees.

c. Flood relief.

(3) Reduce potential for fraud and victimization.

(4) Reduce risks to the residents of the County of Napa from threats to health or safety or economic loss due to flooding.

(b) Regulatory objectives to preserve riparian cover:

(1) Preserve fish and wildlife habitats.

(2) Prevent erosion of stream banks.

(3) Maintain cool water temperatures.

(4) Prevent siltation of stream waters.

(5) Obtain the wise use, conservation and protection of certain of the County's woodland and wildlife resources according to their natural capacilities.

(c) Regulatory objectives and provisions to promote broader economic and and political well-being of the community by:

(1) Promoting the most appropriate use of land throughout the County of Napa.

(2) Preserving the rural atmosphere in the County.

(3) Protecting, conserving and promoting the orderly and efficient development of water and land use resources.

(4) Minimizing dangers to public health and safety from malfunctioning water supply and waste disposal systems in flood hazard areas.

Sec. 10202. Definitions.

In this Ordinance the definition of terms set forth in Sections 10203 through 10209 inclusive, shall be given the meaning indicated, unless the contest clearly requires a different meaning.

Sec. 10203. "Commission".

"Commission" shall mean the Conservation, Development and Planning Commission of Napa County.

Sec. 10204. "District".

"District" shall mean the Napa County Flood Control and Water Conservation District.

Sec. 10205. "Engineer".

"Engineer" shall mean the District Engineer of District.

Sec. 10206. "Hydraulic characteristics".

"Hydraulic characteristics" shall mean the features of a watercourse which determine its water conveyance capacity. They include (without limitation):

(a) Size and configuration of cross section of watercourse.

(b) Alignment of watercourse.

(c) Gradient of watercourse.

(d) Texture of materials along the watercourse.

(e) Amount and type of vegetation within the watercourse.

(f) Size, configuration and other characteristics of structures within the watercourse.

Sec. 10207. "Parcel".

"Parcel" shall mean any plot, lot or acreage shown as a unit on the latest equalized county assessment roll.

Sec. 10208. "Watercourse".

"Watercourse" shall mean one of the natural or artificial channels which convey surface water delineated on that certain map, with accompanying listing approved and adopted by the Board of Supervisors and on file in the Office of Engineer identified as watercourse obstruction riparian cover ordinance map. There shall be included in the watercourse an area extending laterally outward fifty (50) feet beyond the top of the banks on either side of such channel, except that the watercourse of the Napa River from the southern boundary of the County to Zinfandel Lane shall include an area extending laterally outward one hundred (100) feet beyond the top of the banks on either side of its channel. A watercourse shall not include any property situated within the boundaries of any incorporated city. Top of the bank shall mean the upper elevation of land which confines waters flowing in a watercourse to their channel in their normal course of winter flow.

Sec. 10209. "Water conveyance capacity".

"Water conveyance capacity" shall mean the capacity of a watercourse to convey a particular volume of water per unit of time at a particular water surface elevation at any particular point on the watercourse.

Sec. 10210. Permit.

No person shall perform any of the following acts or otherwise alter the hydraulic characteristics of a watercourse without first having obtained a written permit from the Commission pursuant to Section 10213 of this Ordinance:

(a) Deposit or remove any material within a watercourse.

(b) Excavate within a watercourse.

(c) Construct, alter or remove any structure within, upon or across a watercourse.

(d) Plant or remove any vegetation within a watercourse.

(e) Alter any embankment within a watercourse.

Sec. 10211. Exceptions.

The provisions of Section 10210 of this Ordinance shall not apply to:

(a) Any public agency or its contractor.

(b) Any person performing work within a right-of-way of any public agency pursuant to a permit issued by such public agency.

(c) Emergency work necessary to preserve life or property. When emergency work is performed under this Section, the person performing it shall report the pertinent facts relating to the work to the Engineer within ten (10) days after commencement of the work and shall thereafter obtain a permit under Section 10213, and perform such work as may be determined by the Engineer to be reasonably necessary to correct any impairment such emergency work may have caused to the water conveyance capacity of the watercourse.

(d) Work consisting of the operation, repair or maintenance of any lawful use of land existing on the date of adoption of this Ordinance.

Sec. 10212. Application for permit.

A separate application for a permit shall be made to the Commission, on a form approved by the Commission, for each act listed in Section 10210 or any other act which alters the hydraulic characteristics of a watercourse, except that only one application need be made for two or more such acts which are to be done on the same parcel. The application shall include a map of the site and a plan and cost estimate of the proposed development. Such data shall be submitted in such detail as the Engineer may require. When the proposed development includes construction or alterations of structures, three sets of plans and specifications for such work shall be submitted with the application.

Sec. 10213. Issuance of permit.

No application for permit shall be approved and no permit shall be issued when the Commission finds and determines that the proposed work will either:

(a) Substantially impair the water conveyance capacity of the watercourse; or

(b) Destroy a significant amount of riparian cover.

If no such findings are made, the permit shall be issued.

Sec. 10214. Conditions.

The Commission may issue a permit subject to conditions specifically set forth in the permit when the Commission finds that neither of the effects listed in Section 10213 will be likely to result if the conditions are met.

In the development of conditions of approval or reasons for denial, the Commission, in addition to the recommendations provided by the County Departments consulted, may invite comments and recomendations from other governmental offices whose expertise is considered to be pertinent to the subject of the application.

Sec. 10215. Responsibility.

Neither the issuance of a permit nor compliance with the conditions thereof, nor with the provisions of this Ordinance shall relieve any person from any responsibility otherwise imposed by law for damage to persons or property; nor shall the issuance of any permit hereunder serve to impose any liability upon the County of Napa or the District, their officers or employees, for injury or damage to persons or property. A permit issued pursuant to this Ordinance does not relieve the permittee of the responsibility of securing and complying with any other permit which may be required by any other County Ordinance, regional directive or State law.

Sec. 10216. Term of permit; extension; renewal.

The permittee shall begin the work authorized by the permit within sixty (60) days from the date of issuance, unless a different date for commencement of work is set forth in the permit. The permittee shall complete the work authorized by the permit within the time limits specified in the permit, which is no event shall extend more than twelve (12) months from the date of issuance. The permittee shall notify the Engineer at least twenty-four (24) hours prior to the commencement of work. Should the work not be commenced as specified herein, then the permit shall become void; provided, however, that if prior to the date established for commencement of work, the permittee makes written request to the Engineer for an extension of time to commence the work, setting forth the reasons for the required extension, the Engineer may grant such extension. A permit which has become void may be renewed at the discretion of the Engineer upon payment of a renewal fee. If the Engineer does not grant such renewal, a permit for such work may be granted only upon compliance with the procedures herein established for an original application. The permittee, at any time while a permit is in force, may make written request to the Engineer for an extension of time to complete the work covered by the permit. The Engineer shall grant such a request if, in his opinion, such an extention is warranted.

Sec. 10217. Notice of completion.

The permittee shall notify the Engineer in writing of the termination of the work authorized and no work shall be deemed to have been completed until approved in writing by the Engineer following such written notification.

Sec. 10218. Inspection.

The Engineer may cause inspections of the work to be made periodically during the course thereof, and shall make a final inspection following completion of the work. The permitte shall assist the Engineer in making such inspections.

(EXCERPT)

APPENDIX IV-b

______________TOWNSHIP, COUNTY OF OAKLAND, STATE OF MICHIGAN

TOWNSHIP ORDINANCE NO. ______________

FLOOD PLAIN AND WETLANDS PROTECTION ORDINANCES

EFFECTIVE DATE: ____________

An ordinance to protect the watercourses, flood plains and wetlands of ____________________ Township, Oakland County, Michigan; to regulate the use of land areas subject to periodic flooding; to protect economic property values, aesthetic and recreational values, and other natural resource values associated with the flood plains and wetlands of this township to provide for permits for the use of these resource areas; and to provide for penalties for the violation of this ordinance adopted to secure the public health, safety, and general welfare under the combined authority of Act 246 of the Public Acts of 1945, as amended, and Act 184 of the Public Acts of 1943, as amended.

The Township Board of the Township of ___________________, County of Oakland, State of Michigan, ORDAINS:

ARTICLE I - SHORT TITLE

This ordinance shall be known and may be cited as the ____________ Township Flood Plain and Wetlands Protection Ordinance.

ARTICLE II - PURPOSE

Section 1. Consistent with the letter and spirit of Act 246 of the Public Acts of 1945, the Township Board of _________________ Township finds that rapid growth, the spread of development, and increasing demands upon natural resources have had the effect of enroaching upon, despoiling, polluting or eliminating many of its watercourses and wetlands, and other natural resources and processes associated therewith which, if preserved and maintained in an undisturbed and natural condition, constitute important physical, aesthetic, recreation and economic assets to existing and future residents of the Township.

Section 2. Therefore, the purposes of this ordinance are:

A. To provide for the protection, preservation, proper maintenance and use of Township watercourses and wetlands in order to minimize disturbance to them and to prevent damage from erosion, turbidity or siltation, a loss of fish or other beneficial aquatic organisms, a loss of wildlife and vegetation, and/or from the destruction of the natural habitat thereof;

B. To provide for the protection of the Township's potable fresh water supplies from the dangers of drought, overdraft, pollution, or mismanagement;

C. To secure safety from floods; to reduce the financial burdens imposed upon the community through rescue and relief efforts occasioned by the occupancy or use of areas subject to periodic flooding; to prevent loss of life, property damage and other losses and risks associated with flood conditions; to preserve the location, character and extend of natural drainage courses.

ARTICLE VI - WATERCOURSE AND WETLANDS PROTECTION

Section 1. Prohibited Acts.

Except as hereinafter provided in this article, it shall be unlawful for any person without obtaining a written permit therefore from the Township Board to:

A. Deposit or permit to be deposited any material, including structures, into, within or upon any watercourse or wetland area, or within 25 feet of the edge of any watercourse, designated on the Official Maps of the Oakland County Planning Commission.

B. Remove or permit to be removed any material from any watercourse or wetland area, or from any area within 25 feet of any watercourse, designated on the Official Maps of the Oakland County Planning Commission.

Section 2. Permitted Acts.

A. The following operations and uses are permitted in the watercourses and wetlands areas of the Township as a matter of right, subject to the provisions of section one (1):

   (1) Conservation of soil, vegetation, water, fish and wildlife;

   (2) Outdoor recreation including play and sporting areas; field trails for nature study, hiking and horseback riding; swimming, skin diving, boating, trapping, hunting and fishing where otherwise legally permitted and regulated;

   (3) Grazing, farming, gardening and harvesting of crops, and forestry and nursery practices where otherwise legally permitted and regulated;

   (4) Operation and maintenance of existing dams and other water control devices, and temporary alteration or diversion of water levels or circulation for emergency maintenance or aquaculture purposes, if in compliance with state statutes.

B. The following operations and uses are permitted if done pursuant to terms and conditions of a permit approved by the Township Board. Where a final subdivision plat or final site development plan has been approved by the Township Board, such approval, together with any additional terms and conditions attached thereto, shall constitute such a permit:

(1) Docks, bulkheads, boat launching or landing sites;

(2) Municipal or utility use such as water works pumping stations, parks and recreation facilities, when involving any alteration of existing natural conditions of watercourses or wetland areas.

(3) Private recreation facilities as permitted and regulated under section ________ of the Township Zoning Ordinance, and when consistent with the intent and objectives of this Ordinance;

(4) Dams or other water control devices, dredging or diversion of water levels or circulation, or changes in watercourses for the purposes of improving fish or wildlife habitat, recreation facilities or drainage conditions, when consistent with the intent and objectives of this Ordinance and otherwise permitted under state statutes.

(5) Utility transmission lines;

(6) Driveways and roads where alternative means of access are proven to be impractical.

Section 3. Scope of Permits.

All uses and operations permitted or approved by such permits shall be conducted in such a manner as will cause the least possible damage and encroachment or interference with natural resources and natural processes within the watercourses and wetland areas in the Township.

The Township Board shall upon the adoption of a resolution directing the issuance of a permit;

A. Impose such conditions on the manner and extent of the proposed operation, use or activity as are necessary to ensure that the intent of this Ordinance is carried out;

B. Fix a reasonable time within which any removal or deposition operations must be completed;

C. Require the filing with the Township of a cash or surety performance bond, in such form and amount as determined necessary by the Commission to ensure compliance with the approved permit.

Section 4. Permit Procedure.

A. All applicants for a permit to do any of the acts permitted by this Article shall present six copies of the permit application together with other required information and materials to the Township Planning Commission. Thereafter, procedural matters shall be controlled by Article Four (IV).

B. All applications and copies thereof must be accompanied by or include the following information and fee:

(1) Name andaddress of applicant and of applicant's agent, if any and whether applicant is owner, lesee, license, etc. If applicant is not owner, the written consent of the owner, duly acknowledged, must be attached.

(2) Amount and type of material proposed to be removed or deposited, or proposed type of use or activity.

(3) Purpose of proposed removal or deposition operations, use or activity.

(4) Survey and topographical map of the property upon which such operation or use is proposed, prepared in the manner prescribed in subsection C.

(5) Description of the proposed manner in which material will be removed or deposited, structure installed or use carried out.

(6) A filing fee of fifty dollars ($50.00).

C. The permit application shall be accompanied by a survey and topographical map drawn to a scale of no smaller than one inch equals 30 feet, prepared and certified substantially correct by a registered land surveyor or engineer. and including the information listed below. Whenever the cost of the proposed operation does not exceed $100.00, the plans and specifications need not be prepared by a licensed practitioner:

(1) Name and address of owner of record of the affected property, and of applicant if other than owner, location and dimensions of all boundary lines, names of the owners of record of adjoining properties and of properties directly across any road, graphic scale, north arrow and date.

(2) Existing contour data for the entire property with a vertical interval of no more than ten feet, and contour data at an interval of no more than one foot for all areas to be disturbed by the proposed operation, extending for a distance of at least 50 feet beyond the limits of such areas. Indicated elevations shall be based on an established datum which specify the relationship to sea level.

(3) Specification of the extent of all areas to be disturbed, the depth to which removal or deposition operations are proposed, and the angle of repose of all slopes of deposited materials and/or sides of channels or excavations resulting from removal operations.

(4) An area map at a scale of one inch equals 200 feet showing property lines and proposed changes in the location and extent of existing watercourses and wetland areas.

Section 5. Exceptions for Small Wetland Areas

This Ordinance shall not apply to wetlands as defined and designated under Article three (III) which cover an area of less than one (1) acre.

Section 6. Inspections

The permit applicant or his agent proceeding with approved operations shall carry on his person or have readily available the approved permit and show same to any agency or agent of the Township whenever requested.

Operations conducted under such permits shall be open to Inspection at any time by any agency or agent of the Township or State.

Section 7. Invalidated Permits

Subject to the procedures in Article four (IV), any decision regarding a permit application under this Ordinance shall be judicially reviewable. In the event that, based upon proceedings and decision of an appropriate court of the State, a taking is declared, the Township may, within the time specified by such court, elect to:

A. Institute condemnation proceedings to acquire the applicants' land in fee by purchase at fair market value; or

B. Approve a permit application with lesser restrictions or conditions.

Section 8. Penalties and Enforcement

A. Any person found guilty of violating any of the provisions of this ordinance shall be punished by a fine not to exceed $100.00 or imprisonment not to exceed 90 days, or by both such fine and imprisonment in the discretion of the court. The commission, in addition to other remedies, may institute any appropriate action or proceeding to prevent, abate or restrain the violation. Each day's continuance of a violation shall be deemed a separate and distinct offense.

B. The grant or denial or a permit shall not have any effect on any remedy of any person at law or in equity; Provided, that where it is shown that there is a wrongful failure to comply with this ordinance, there shall be a rebuttable presumption that the obstruction was the proximate cause of the flooding of the land of any person bringing suit.

C. Any person violating the provisions of this Ordinance shall become Liable to the Township for any expense or loss or damage occasioned by the Township by reason of such violation.

Section 9. Existing or Prior Conditions

Any structures, dwelling, construction or other operations existing within a watercourse or wetland area, as shown on the Official Maps prior to the effective date of this Ordinance shall be exempt from this law and permitted to continue, provided that any structure or use which does not conform to the provisions of this ordinance or subsequent amendment may not be

A. changed to another nonconforming use,

B. re-established after discontinuance for one year,

C. extended except in conformity with this ordinance, or

D. Rebuilt or repaired after damage exceeding 70 percent of the fair sales value of the structure immediately prior to damage.

All nonconforming uses of land shall be discontinued and all nonconforming building or structures shall be torn down, altered or otherwise made to conform within 25 years from the date of adoption, of this ordinance.

Section 10. Other Regulations

This Ordinance does not obviate the necessity for the applicant to obtain the assent or permit required by any other agency before proceeding with operations under a permit approved under this Ordinance. Obtaining such other permits as may be required is solely the responsibility of the applicant, and no operations shall be initiated by the applicant until such permits have been issued.

ARTICLE VII - EFFECTIVE DATE

This Ordinance shall take effect immediately.

From standards for Soil Erosion
and Sediment Control in New
Jersey. New Jersey State Soil
Conservation Committee.

APPENDIX IV-c
MODEL MUNICIPAL LAND DISTURBANCE ORDINANCE TO CONTROL SOIL EROSION AND SEDIMENTATION

An ordinance to establish regulations for controlling soil erosion and sedimentation within the municipality of ________________.

ARTICLE I
TITLE AND PURPOSE

A. TITLE

This ordinance shall be known as the "________________ Municipal Soil Erosion and Sediment Control Ordinance."

B. PURPOSE

The purpose of this ordinance is to control soil erosion and sediment damages and related environmental damage by requiring adequate provisions for surface water retention and drainage and for the protection of exposed soil surfaces in order to promote the safety, public health, convenience and general welfare of the community.

ARTICLE II
DEFINITIONS

A. RULES APPLYING TO TEXT

For the purpose of this ordinance certain rules of word usage apply to the text as follows:

1. Words used in the present tense include the future tense: and the singular includes the plural, unless the context clearly indicates the contrary.

2. The term "shall" is always mandatory and not discretionary: the word "may" is permissive.

3. The word or term not interpreted or defined by this article shall be used with a meaning of common or standard utilization.

B. DEFINITIONS

The following definitions shall apply in the interpretation and enforcement of this ordinance, unless otherwise specifically stated:

1. Applicant- A person, partnership, corporation or public agency requesting permission to engage in land disturbance activity.

2. Critical Area- A sediment-producing highly erodible or severly eroded area.

3. Excavation or Cut- Any act by which soil or rock is cut into, dug, quarried, uncovered, removed, displaced or relocated.

4. Erosion - Detachment and movement of soil or rock fragments by water, wind, ice and gravity.

5. Erosion and Sediment Control Plan- A plan which fully indicates necessary land treatment measures, including a schedule of the timing for their installation, which will effectively minimize soil erosion and sedimentation. Such measures shall be in accordance with standards as adopted by the State Soil Conservation Committee.

6. Farm Conservation Plan- A plan which provides for use of land, within its capabilities and treatment, within practical limits, according to chosen use to prevent further deterioration of soil and water resourses.

7. Land- Any ground, soil, or earth including marshes, swamps drainageways and areas not permanently covered by water within the municipality.

8. Land Disturbance- Any activity involving the clearing, grading, transporting, filling and any other activity which causes land to be exposed to the danger of erosion.

9. Permit- A certificate issued to perform work under this ordinance.

10. Mulching- The application of plant residue or other suitable materials to the land surface to conserve moisture, hold soil in place, and aid in establishing plant cover.

11. Sediment- Solid material, both mineral and organic, that is in suspension, is being transported, or has been moved from its site of origin by air, water or gravity as a product of erosion.

12. Sediment Basin- A barrier or dam built at suitable locations to retain rock, sand, gravel, silt or other material.

13. Soil- All unconsolidated mineral and organic material of any origin.

14. Soil Conservation District- A governmental subdivision of this State, which encompasses this municipality, organized in accordance with the provisions of Chapter 24, Title 4, N.J.R.S.

15. Site- Any plot, parcel or parcels of land.

16. State Soil Conservation Committee- An agency of the State established in accordance with the provisions of Chapter 24, Title 4, N.J.R.S.

17. Stripping- Any activity which significantly disturbs vegetated or otherwise stabilized soil surface including clearing and grubbing operations.

ARTICLE III
PROCEDURE

A. REGULATION

1. No land area shall be disturbed by any person, partnership, corporation, municipal corporation or other public agency within this municipality unless; the applicant has submitted to the building inspector a plan to provide for soil erosion and sediment control for such land areas in accordance with the Standards for Erosion and Sediment Control adopted by

the New Jersey State Soil Conservation Committee and administered by the ____________________ Soil Conservation District and such plan has been approved; and a valid land disturbance permit has been issued by the building inspector except as exempted by ARTICLE V.

B. DATA REQUIRED

The applicant must submit a separate soil erosion and sediment control plan for each noncontiguous site. The applicant may consult with the ____________________ Soil Conservation District in the selection of appropriate erosion and sediment control measures and the development of the plan. Such plan shall contain:

1. Location and description of existing natural and man-made features on and surrounding the site including general topography and soil characteristics and a copy of the soil conservation district soil survey (where available).
2. Location and description of proposed changes to the site.
3. Measures for soil erosion and sediment control which must meet or exceed STANDARDS FOR SOIL EROSION AND SEDIMENT CONTROL adopted by the State Soil Conservation Committee. STANDARDS shall be on file at the offices of the local soil conservation district and the township clerk.
4. A schedule of the sequence of installation of planned erosion and sediment control measures as related to the progress of the project including anticipated starting and completion dates.
5. All proposed revisions of data required shall be submitted for approval.

C. REVIEW AND APPROVAL

Soil erosion and sediment control plans shall be reviewed by the municipal engineer (or other designated official) and approved when in conformance with the Standards for Erosion and Sediment Control.

The municipal engineer may seek the assistance of the ____________ soil conservation district in the review of such plans and may deem as approved those plans which have been reviewed and determined adequate by the said district.

ARTICLE IV
PRINCIPLES AND REQUIREMENTS

A. GENERAL DESIGN PRINCIPLES

Control measures shall apply to all aspects of the proposed land disturbance and shall be in operation during all stages of the disturbance activity. The following principles shall apply to the soil erosion and sediment control plan.

1. Stripping of vegetation, grading or other soil disturbance shall be done in a manner which will minimize soil erosion.

2. Whenever feasible, natural vegetation shall be retained and protected.

3. The extent of the disturbed area and the duration of its exposure shall be kept within practical limits.

4. Either temporary seeding, mulching or other suitable stabilization measure shall be used to protect expose critical areas during construction or other land disturbance.

5. Drainage provisions shall accommodate increased runoff, resulting from modified soil and surface conditions, during and after development or disturbance. Such provisions shall be in addition to all existing requirements.

6. Water runoff shall be minimized and retained on site wherever possible to facilitate ground water recharge.

7. Sediment shall be retained on site.

8. Diversions, sediment basins, and similar required structures shall be installed prior to any on-site grading or disturbance.

B. MAINTENANCE

All necessary soil erosion and sediment control measures installed under this ordinance, shall be adequately maintained for one year after completion of the approved plan or until such measures are permanently stabilized as determined by the municipal engineer. The municipal engineer shall give the applicant upon request a certificate indicating the date on which the measures called for in the approved plans were completed.

C. MAINTENANCE BONDS (As required by local conditions)

D. FEES (As required by local conditions)

E. PENALTIES FOR VIOLATIONS (As required by local conditions)

1. Monetary

2. Stop orders

3. Injunctive relief

ARTICLE V
EXEMPTIONS

The following activities are specifically exempt from this ordinance:

1. Land disturbance associated with existing one and two family dwellings.

2. Use of land for gardening primarily for home consumption.

3. Agricultural use of lands when operated in accordance with a farm conservation plan approved by the local soil conservation district or when it is determined by the local soil conservation district that such use will not cause excessive erosion and sedimentation.

ARTICLE VI
INSPECTION AND ENFORCEMENT

The requirements of this ordinance shall be enforced by the municipal engineer who shall also inspect or require adequate inspection of the work. If the municipal engineer finds existing conditions not as stated in the applicant's erosion and sediment control plan he may refuse to approve further work and may require necessary erosion and sediment control measures to be promptly installed and may seek other penalties as provided in ARTICLE IV E.

ARTICLE VII
APPEALS

Appeals from decisions under this ordinance may be made to the municipal governing body in writing within ten days from the date of such decision. The appellant shall be entitled to a hearing before the municipal governing body within thirty days from date of appeal.

ARTICLE VIII
VALIDITY AND SEVERABILITY

If any part of this ordinance is found not valid, the remainder of this ordinance shall remain in effect.

MODEL SOIL EROSION AND SEDIMENT CONTROL ORDINANCE TO AMEND MUNICIPAL SUBDIVISION AND ZONING ORDINANCES

An ordinance to amend municipal subdivision and land use ordinances and establish regulations for controlling soil erosion and sedimentation within the municipality of ____________________________.

ARTICLE I
TITLE AND PURPOSE

A. TITLE

This ordinance shall be known as the "______________________________________ Municipal Soil Erosion and Sediment Control Ordinance."

B. PURPOSE

The purpose of this ordinance is to control soil erosion and sediment damages and related environmental damage by requiring adequate provisions for surface water retention and drainage and for the protection of exposed soil surfaces in order to promote the safety, public health, convenience and general welfare of the community.

ARTICLE II
DEFINITIONS

A. RULES APPLYING TO TEXT

For the purpose of this ordinance certain rules of word usage apply to the text as follows:

1. Words used in the present tense include the future tense; and the singular includes the plural, unless the context clearly indicates the contrary.
2. The term "shall" is always mandatory and not discretionary; the word "may" is permissive.
3. The word or term not interpreted or defined by this article shall be used with a meaning of common or standard utilization.

B. DEFINITIONS

The following definitions shall apply in the interpretation and enforcement of this ordinance, unless otherwise specifically stated:

1. Applicant - A person, partnership, corporation or public agency requesting permission to engage in land disturbance activity.
2. Critical Area - A sediment-producing highly erodible or severly eroded area.
3. Excavation or Cut - Any act by which soil or rock is cut into, dug, quarried, uncovered, removed, displaced or relocated.

4. Erosion - Detachment and movement of soil or rock fragments by water, wind, ice and gravity.

5. Farm Conservation Plan - A plan which provides for use of land, within its capabilities and treatment, within practical limits, according to chosen use to prevent further deterioration of soil and water resources.

6. Land - Any ground, soil, or earth including marshes, swamps, drainageways and areas not permanently covered by water within the municipality.

7. Land Disturbance - Any activity involving the clearing, grading, transporting filling and any other activity which causes land to be exposed to the danger of erosion.

8. Permit - A certificate issued to perform work under this ordinance.

9. Mulching - The application of plan residue or other suitable materials to the land surface to conserve moisture, hold soil in place, and aid in establishing plant cover.

10. Sediment Basin - A barrier or dam built at suitable locations to retain rock, sand, gravel, silt or other material.

11. Sediment - Solid material, both mineral and organic, that is in suspension, is being transported, or has been moved from its site of origin by air, water or gravity as a product of erosion.

12. Erosion and Sediment Control Plan - A Plan which fully indicates necessary land treatment measures, including a schedule of the timing for their installation, which will effectively minimize soil erosion and sedimentation. Such measures shall be equivalent to or exceed standards adopted by the New Jersey State Soil Conservation Committee and administered by the ______________________________ Soil Conservation District.

13. Soil - All unconsolidated mineral and organic material of any origin.

14. Soil Conservation District - A governmental subdivision of this State, which encompasses this municipality, organized in accordance with the provisions of Chapter 24, Title 4, N.J.R.S.

15. Site - Any plot, parcel or parcels of land.

16. Stripping - Any activity which significantly disturbs vegetated or otherwise stabilized soil surface including clearing and grubbing operations.

ARTICLE III
PROCEDURE

A. REGULATION

No site plan or preliminary plan submitted to the planning board pursuant to the subdivision or land use ordinance of ________________ (municipality) shall be granted approval unless it includes a soil erosion and sediment control plan developed in accordance with the Standards for Soil Erosion and

Sediment Control adopted by the New Jersey State Soil Conservation Committee and administered by the ____________________ Soil Conservation District. The applicant may consult with the ____________________ soil conservation district in the development of the plan and the selection of appropriate erosion and sediment control measures. The applicant shall bear the final responsibility for the installation and construction of all required soil erosion and sediment control measures according to the provisions of this ordinance except as exempted by ARTICLE V.

B. DATA REQUIRED

The applicant must submit to the planning board a separate soil erosion and sediment control plan for each subdivision, site plan review, special exception, zoning variance or planned unit development application. Such plan shall contain:

1. Location and description of existing natural and man-made features on and surrounding the site including general topography and soil characteristics and a copy of the soil conservation district soil survey where available.

2. Location and description of proposed changes to the site.

3. Measures for soil erosion and sediment control which shall be equivalent to or exceed STANDARDS FOR SOIL EROSION AND SEDIMENT CONTROL adopted by the New Jersey State Soil Conservation Committee and administered by the ____________________ Soil Conservation District. Such STANDARDS shall be on file at the offices of the soil conservation district and the municipal clerk.

4. A schedule of the sequence of installation of planned erosion and sediment control meausres as related to the progress of the project including anticipated starting and completion dates.

5. All proposed revisions of data required shall be submitted for approval.

C. REVIEW AND APPROVAL

Erosion and sediment control plans shall be reviewed by the planning board and approved when in conformance with the Standards for Erosion and Sediment Control. The board may seek the assistance of the ____________________ soil conservation district in the review of such plans and may deem as approved those plans which have been reviewed and determined adequate by the ________________ soil conservation district.

ARTICLE IV
PRINCIPLES AND REQUIREMENTS

A. GENERAL DESIGN PRINCIPLES

Control measures shall apply to all aspects of the proposed site development involving land disturbance and shall be in operation during all stages of the disturbance activity. The following principles shall apply to the soil erosion and sediment control plan.

1. Stripping of vegetation, grading or other soil disturbance shall be done in a manner which will minimize soil erosion.
2. Whenever feasible, natural vegetation shall be retained and protected.
3. The extent of the disturbed area and the duration of its exposure shall be kept within practical limits.
4. Either temporary seeding, mulching or other suitable stabilization measure shall be used to protect exposed critical areas during construction or other land disturbance.
5. Drainage provisions shall accommodate all increased runoff resulting from modifications of soil and surface conditions during and after development or disturbance. Such provisions shall be in addition to existing requirements.
6. Water runoff shall be minimized and retained on site wherever possible to facilitate ground water recharge.
7. Sediment shall be retained on site.
8. Diversions, sediment basins, and similar required structures shall be installed prior to any on-site grading or disturbance.

B. MAINTENANCE

All necessary soil erosion and sediment control measures installed under this ordinance, shall be adequately maintained for one year after completion of the approved plan or until such measures are permanently stabilized as determined by the building inspector. The building inspector shall give the applicant upon request a certificate indicating the date on which the measures called for in the approved plans were completed.

C. MAINTENANCE BONDS (As required by local conditions)

D. FEES (As required by local conditions)

E. PENALTIES FOR VIOLATIONS (As required by local conditions)

1. Monetary
2. Stop orders
3. Injunctive relief

ARTICLE V
EXEMPTIONS

The following activities are specifically exempt from this ordinance:

1. Minor subdivisions.
2. Site plans for development where the land will not be disturbed.

3. Agricultural use of lands when operated in accordance with a farm conservation plan approved by the local soil conservation district or when it is determined by the local soil conservation district that such use will not cause excessive erosion and sedimentation.

ARTICLE VI
INSPECTION AND ENFORCEMENT

The requirements of this ordinance shall be enforced by the municipal engineer who shall also inspect or require adequate inspection of the work carried out pursuant to site plan approval. If the municipal engineer finds existing conditions not as stated in the applicant's erosion and sediment control plan he may refuse to approve further work and may required necessary erosion and sedimentation control measures to be promptly installed and may seek other penalties as provided in ARTICLE IV E.

APPEALS

Appeals from decisions under this ordinance shall be made in the manner prescribed by the ordinance which it amends.

ARTICLE VIII
VALIDITY AND SEVERABILITY

If any part of this ordinance is found not valid, the remainder of this ordinance shall remain in effect.

APPENDIX IV-d

(Quotes are from Snohomish County Shoreline
Management Master Program, June 1974)

Figure 1 identifies the basic steps in the evaluation process, which will be referred to in the following discussion.

Step 1: Application Received

The guidelines provide that "any development of which the total cost, or fair market value, exceeds $1,000, or any development which materially interferes with normal public use of the water or shorelines" requires a permit from the local agency. While the legislation defines a few exceptions, virtually every proposal for more than one residential or any commercial and industrial use will require a local permit.

Step 2: Shoreline of Statewide Significance?

Although streams are not contained in the act's list of shorelines of statewide significance, they are covered under the remaining steps.

Step 3: Complies with Use Regulations for Environment? F-54

Figure 2 specifies the various uses appropriate to each district.

Figure 1

Snohomish Management Master Program Evaluation Process

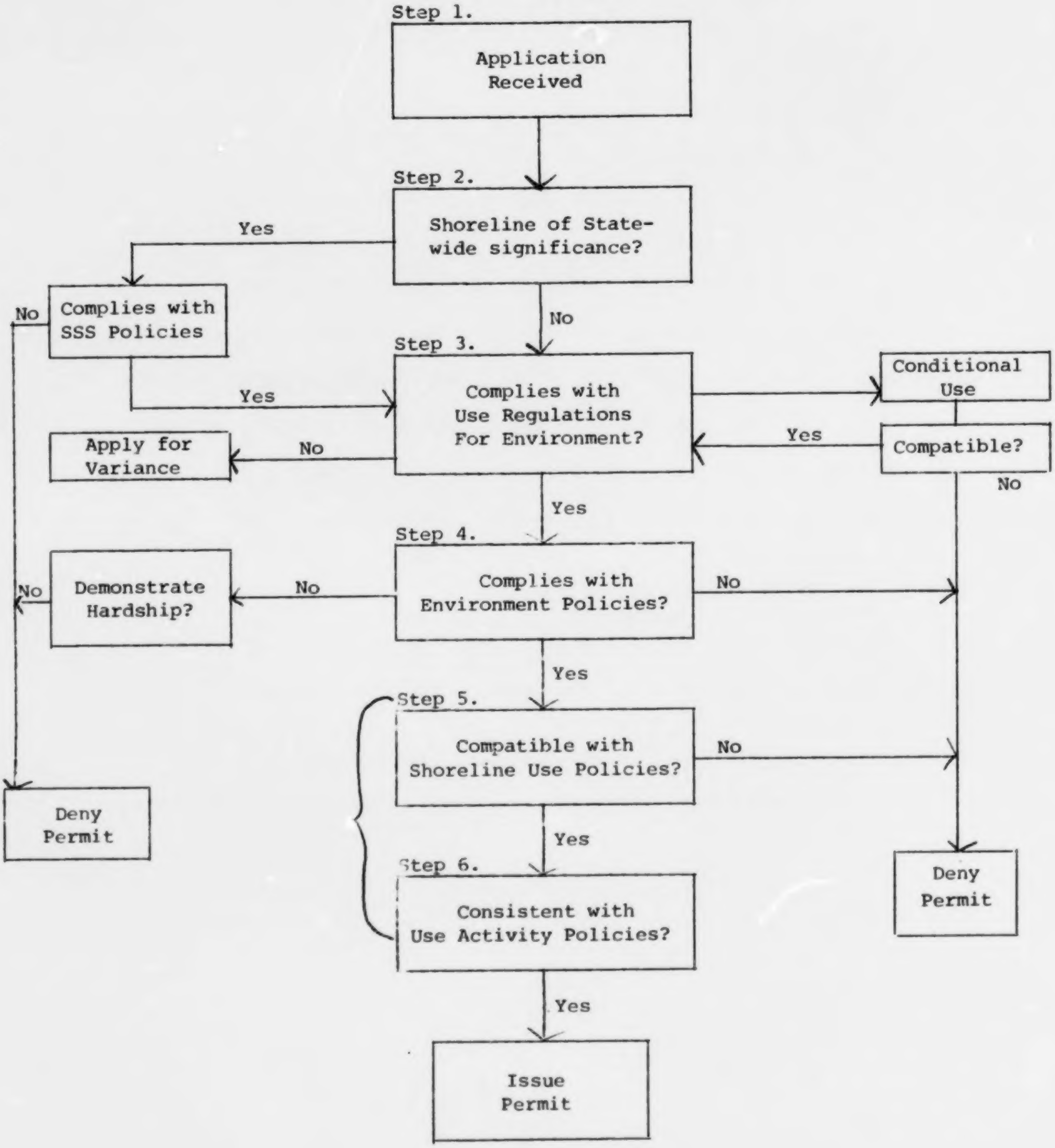

Step 1.
Application Received
Step 2.
Shoreline of State-wide significance?
Yes
No
Complies with SSS Policies
No
Yes
Step 3.
Complies with Use Regulations For Environment?
Conditional Use
Yes
Compatible?
No
Apply for Variance
No
Yes
Step 4.
Complies with Environment Policies?
No
Demonstrate Hardship?
No
No
Yes
Step 5.
Compatible with Shoreline Use Policies?
No
Yes
Step 6.
Consistent with Use Activity Policies?
Yes
Deny Permit
Deny Permit
Issue Permit

Figure 2

USE ACTIVITY - SHORELINE ENVIRONMENT

COMPATIBILITY MATRIX

USE ACTIVITY	URBAN	SUBURBAN	RURAL	CONSERVANCY	NATURAL
Agricultural Practices	0	0	0	0	0
Aquaculture	0	0	0	0	Δ
Archeological Areas and Historic Sites	*	*	*	*	*
Breakwaters	0	0	0	*	X
Bulkheads	0	0	0	*	X
Commercial Development	0	*	*	*	X
Dredging	0	0	0	*	X
Forest Management Practices	Δ	Δ	0	0	*
Jetties and Groins	0	0	0	*	X
Landfill and Solid Waste Disposal	*	*	*	*	X
Marinas	0	Δ	0	*	X
Mining	0	X	0	*	X
Piers	0	0	0	*	*
Ports and Water Related Industry	0	X	Δ*	Δ*	X
Recreation	0	0	0	0	0
Residential Development	0	0	0	*	X
Roads and Railroads	0	*	*	*	X
Shoreline Stabilization and Flood Protection	0	0	0	Δ	Δ
Signs	0	0	0	0	*
Utilities	0	0	0	0	*

0 Use permitted in the environment subject to regulatory controls

X Use prohibited in the environment

Δ Use permitted as a Conditional Use in the environment

* See regulations for special circumstances

Within each district there are general regulations which apply to the permitted use, and specific standards which apply to the individual permitted use within that area. For example, the general regulations for residential uses are as follows:

REGULATIONS

General

1. Residential development over water shall be prohibited.
2. Applications for development of subdivisions shall include the following information (at a minimum):
   a. Detailed statement (graphic and textual) of proposed erosion control plans to be utilized both during and after construction;
   b. Detailed statement (graphic and textual) of any proposed alterations to the natural character of the shoreline;
   c. Sewage disposal plans (to include statement from the Snohomish Health District attesting to their acceptability);
   d. Storm drainage plans and provisions;
   e. Provisions for lot owner access to the water body (where appropriate;
   f. Provisions for public access to the water body (where appropriate);
3. Filling of, or into, water bodies to their associated wetlands for the purpose of subdivision construction shall not be permitted.
4. Placement of fill to assist in flood-proofing of residences shall be allowed subject to appropriate flood control regulations.
5. Subdivisions or multiple family developments shall not be approved for which flood control, shoreline protection measures, or bulkheading will be required to protect residential lots. Conclusive

evidence that such structures will be necessary for the safety of the residents on all or part of the subdivision or development shall be grounds for denial of all or part of the application, respectively.

6. All utility lines shall be underground.

The specific regulations for residential use in a rural environment are:

Rural Environment: Use Regulations: Residential

1. Residential subdivisions to include short plats, shall maintain an overall density of less than one dwelling unit per acre of land.
2. Multi-family dwellings shall be prohibited in the Rural Environment except when contained in a Planned Residential Development approved pursuant to Chapter 18.38 of the Sno. Co. Zoning Code.
3. Residences shall maintain a 50-foot setback from the ordinary high water mark in Rural Environment.
4. Alterations of topography and the land-water interface shall be minimized. The need for such alteration shall be documented in the permit application.

Step 4: Comply with Environment Policies?

Each district also has a set of environment policies which apply to any kind of use within the district. The policies for a rural district are as follows:

Management Policies: Rural Environment: Applicable to All Uses

1. Protect prime agricultural lands from incompatible and preemptive patterns of development.
2. Restrict intensive development along undeveloped rural environment shorelines.
3. Permit opportunities for recreational uses compatible with agricultural activities.

4. Maintain existing and potential areas having a high capability to support intensive agricultural uses for present and future agricultural needs.

5. Require new developments in Rural Environments to reflect the character of the surrounding area by limiting residential density, providing permanent open space, and by maintaining adequate building setbacks from the water to prevent shoreline resources from being destroyed for other rural types of uses.

6. Permit public and private recreation facilities which can be located and designed to minimize conflicts with agricultural activities. Examples of such facilities include linear water access, trail systems and boat launching sites.

7. Encourage farm management practices which will minimize erosion and the flow of waste material into water courses.

8. Restrict industrial and commercial development in the Rural Environment.

9. Prohibit industrial, commercial (except farm produce sales) and extensive residential development on prime agricultural lands.

10. Restrict the density of residential development in the Rural Environment except in those limited areas which are suitable for recreation home-oriented use.

11. Provide for sand, gravel and mineral extraction in suitable areas which are not designated as prime agricultural land.

12. Allow beach enrichment projects when it can be shown that other portions of the shoreline will not be adversely affected.

Step 5: Compatible with Shoreline Use Policies?

The following general development policies in shorelands are applicable to all environmental districts:

Goal: Assure appropriate conservation and development of Snohomish County's shorelines by allowing those uses which are particularly dependent upon their location on and use of shorelines, as well as other development which provides an opportunity for substantial numbers of people to enjoy the shorelines. This must be done in a manner which will achieve an orderly balance of shoreline uses that do not unduly diminish the quality of the environment.

Policies:

1. Permit only those uses or conditions which allow optional uses for future generations, unless identified benefits clearly compensate for the physical, social and/or economic loss to future generations.

2. Assure that all uses and developments are as compatible as possible with the site, the surrounding area and the environment.

3. Provide site development performance standards and other appropriate criteria to developers indicating minimum acceptable standards to be achieved.

4. Identify all existing inappropriate uses and formulate a relocation program, using a variety of incentives to accomplish this objective.

5. Foster uses which protect the potential long-term benefits to the public from compromise by short-term economic gain or convenience.

6. Encourage multiple use of shorelines where location and integration of compatible uses or activities is feasible.

7. Shoreline land and water areas which are particularly suited for specific and appropriate uses should be reserved for such uses whether they are existing or potential.

8. Prohibit uses not water surface nor shoreline dependent, which permanently alter the shoreline, conflict with, or preempt other shoreline dependent uses.

9. Allow uses, on a specified interim basis, which are not shoreline related, if not permanent and if not requiring permanent modifications of natural shorelines.

10. Implement a management system which will plan for and permit all reasonable and appropriate uses by providing a system of priorities. Those priorities will be established for each designated environment using the following criteria:

a. Protection and enhancement of natural areas or systems - those identified as containing or having unique geological, ecological or biological significance;

b. Water dependent uses - all uses that cannot exist in any other location and are dependent on the water by reason of the intrinsic nature of their operations;

c. Water related uses - those uses which do not depend on a waterfront location to continue their operation, but whose operation is facilitated economically by a shoreline location.

d. Non-water related uses - those uses which do not need a waterfront location to operate though they may need easements or utility corridors for access to the water;

e. Prohibited uses - those uses which have no relation to the water and whose operation is intrinsically harmful to the shoreline.

11. Initiate and support continuing biological, geological, ecological, and economic studies of shoreline systems, which will provide a continuously updated data base against which the impact of any proposal relative to the Snohomish County Master Program can be judged.

12. Require all developments to plan for and control runoff and when necessary treat it before discharging from the site.

Step 6: Consistent with Use-Activity Policies?

Use-activity policies are described for each category of permitted use in each environment district. Since they are general policies which require judgmental and evaluative decisions, they are different from the specific standards of regulations. Thus each permitted use is evaluated on the basis of policies as well as specific regulatory standards. Following are the use-activity policies for residential use, and a sample of the specific regulations.

RESIDENTIAL DEVELOPMENT

INTRODUCTION

The following policies and regulations are to be recognized in the development of any subdivision on the shorelines of the state. To the extent possible, planned unit developments (sometimes called cluster developments) should be encouraged within the shoreline area. Within planned unit developments, substantial portions of land are reserved as open space or recreational areas for the joint use of the occupants of the development. This land may be provided by allowing houses to be placed on lots smaller than the legal minimum size for normal subdivisions, as long as the total number of dwellings in the planned unit development does not exceed the total allowable in a regular subdivision.

POLICIES

1. Encourage the use of the planned residential development concept in all shoreline subdivisions.
2. Require that subdivisions be designed at a level of density, site coverage, and occupancy compatible with the physical capabilities of the shoreline and waterbody.
3. Require that subdivisions be designed so as to adequately protect the water, shoreline aesthetic characteristics, and vistas.
4. Encourage subdividers to provide public pedestrian access to the shorelines within the subdivision.
5. Encourage subdividers to provide all residents within the subdivision with adequate easily accessible and usable access to the water when topographically feasible.
6. Prohibit residential development over water.
7. Require that residential developers submit a plan for approval indicating how they intend to maintain shoreline stability and control erosion, during and after construction.
8. Require that sewage disposal facilities, as well as water supply facilities, be provided in accordance with appropriate State and local health regulations. Storm drainage facilities must be separate, not combined with sewage disposal systems.

9. Require that adequate water supplies be available so that the groundwater quality and quantity will not be endangered by overpumping.

10. Do not allow residential development on shorelines which would be dependent on future bulkheading or other shoreline fortification for protection.

11. Floating homes or commercial floats are to be located at moorage slips approved in accordance with the guidelines dealing with marinas, piers, and docks. In planning for floating homes or commercial enterprises, local governments should ensure that waste disposal practices meet local and state health regulations, that the units are not located over highly productive fish food areas, and that the units are located and designed to be compatible with the intent of the designated environments.

SECTION V

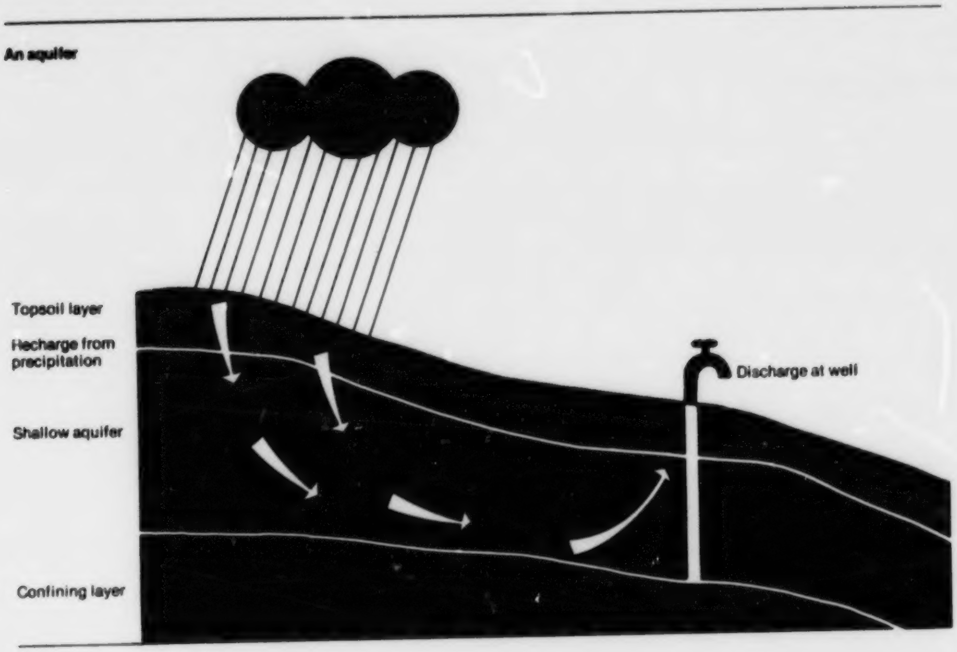
AQUIFERS

A. Introduction

Most of us are concerned about the water quality of lakes, streams, and rivers; when they become polluted or depleted, public outcry demands action. Though this surface water is an important part of the hydrologic cycle (discussed in Section IV), it is only part. Another equally critical element in that cycle, and in our water resources, is groundwater--water which occurs beneath the surface. However, pollution and depletion of our groundwater resources are not so visible to the public eye. As a result of their invisibility and the consequent lack of information and knowledge about groundwater hydrology, the protection of our groundwater resources has created little public concern or legislative activity until recently, with the recent research by EPA on the quality of public water supply and the passage of the Safe Drinking Water Act in December, 1974, there has been a significant increase in the attention paid to our underground water supplies.

As Figure V-1 shows, groundwater is contained in underground formations called aquifers, which may be composed of consolidated rocks such as limestone and basalt or unconsolidated gravels and sands. This stored water in aquifers is released to the surface through wells and springs or by seepage into lakes, rivers, and wetlands. Just as groundwater ultimately returns to the surface, it is also replenished from the surface. Water from streams and lakes seeps down into an aquifer and, where an aquifer or a transmitting formation is exposed to the surface, precipitation percolates directly into

Figure V-1



the aquifer. Consequently, the groundwater reservoirs moderate surface flow; they absorb water during rains or periods of high flow and then gradually release it during periods of low flow.

Although groundwater is directly related to surface water, it is also an important resource in its own right. More than 50 per cent of the population is dependent upon this resource for its drinking water. Vast agricultural enterprises utilize groundwater for irrigation. Commercial and industrial processes are similarly dependent. In total, groundwater accounts for more than 300 billion gallons of water per day for a host of users. Yet in order to meet the needs of the users, the water must be available on location at a certain quality and quantity. To insure availability, groundwater should be treated as a limited and sensitive renewable resource.

On a national scale the supply of groundwater far outruns current demand, but there are severe shortages at the local and regional level. In arid sections of Arizona and Southern California, there is a growing problem of groundwater depletion caused in large part by the increased demands of population and economic growth. In turn, the depletion leads to huge water diversion projects in which water is diverted from sources far outside of the depleted area. In other cases, population growth and economic development are joined by natural phenomena such as drought to decrease groundwater supplies. This has been the case in Long Island and parts of Florida. Consequently, as with other renewable resources, groundwater needs to be conserved--used wisely--in order to insure continued availability.

Groundwater differs in some important ways from other renewable resources. Unlike agricultural or forested areas, there are few private incentives to foster the conservation of groundwater. Farmers and loggers have a direct economic incentive to maintain their renewable resource so that the private market operates to insure protection. Groundwater, on the other hand, is essentially a public good with few private economic incentives for its preservation. Each user acts as if the groundwater were entirely his, as if his actions had no bearing on the future of the resource. When all groundwater users act in this fashion, the resource is quickly degraded or depleted or both. Thus, the role for local agencies is to establish an incentive for the protection of this renewable resource.

At all levels of government, the legislation protecting groundwater has tended to be piecemeal. It often addresses significant causes of groundwater problems such as mine wastes, septic system effluents, well injection of liquid wastes, and the location of landfill sites, but little legislation addresses the question of groundwater protection directly. Until the passage of the Safe Drinking Water Act last December, the federal act that came closest to answering this need is Section 208 of the Federal Water Pollution Control Act Amendments of 1972. With its direct reference to problems of aquifer contamination, its intention is clearly to preserve these resources. The Safe Drinking Water Act imposes immediate restrictions on well injections of wastes and mandates the Environmental Protection Agency to research methods of protecting underground water sources.

In preparing this report, we found considerable interest in groundwater protection and specifically aquifer protection, but most of the work is still at the beginning stages of defining the problem and is not yet to the actual implementation stage. A few communities have implemented programs and these are described in this section.

B. Groundwater Hydrology and the Public Purpose

Most of us seldom think about aquifers and the process of groundwater hydrology, but the pollution or depletion of local groundwater resources can make a community instantly aware of the importance of this resource. How important are aquifers to the public purpose?

1. Aquifers are natural reservoirs for groundwater used for drinking and irrigation. Though some communities depend upon surface water supplies in lakes and streams for drinking and irrigation, many others depend upon

wells drilled into aquifers for part or all of their water. Most rural areas depend upon groundwater, and the states of California, Arizona, Texas, Arkansas, and Louisiana pump one-half of all the water taken from wells in the country. These and similar areas must protect groundwater so that the quantity of water entering the aquifer meets their needs.

2. Aquifers are natural filters for groundwater used for drinking and related purposes. Percolation of precipitation through the soil and overlying formations filters many impurities, and as groundwater moves through the water-bearing formations of aquifers, it is further filtered. But this filtering property of aquifers is not absolute. Leaking septic tanks and sewage lines, unsealed landfill sites, and sewage and solid waste disposal sites can allow pollutants to pass directly into groundwater reserves where the water table is near the surface, the soil mantle is very thin, or the aquifer very permeable. In these cases concern must be directed toward the qualtiy of water entering the aquifer.

3. Aquifers are interconnected with surface water systems in lakes, streams, and wetlands. Some aquifers depend for part or all of their recharge upon seepage from lakes and streams. Likewise, some streams and ponds, and many wetlands, depend upon flow from aquifer-fed springs or seeps for supplementary water during dry periods. Thus pollution or depletion of surface water may similarly affect groundwater reserves, and vice versa. Here concern must be with both the quality and quantity of water entering and leaving the groundwater reserve.

Because of these three major functions--as a reservoir, as a filter, and as part of the hydrologic cycle--aquifers are important public resources. The following, more detailed discussion of groundwater hydrology will show how aquifers serve the public interest.

1. Aquifers as Natural Groundwater Reservoirs

An aquifer stores, dispenses, and transmits water. The amount of water an aquifer can hold and the rate at which it can yield and conduct groundwater depend upon two properties of the material that composes it--porosity and permeability.

Porosity is the amount of open space between the rocks, sands, gravels, and other materials composing the aquifer. The size of the particles and of the spaces between them is not the important factor in determining porosity; rather it is the percentage of open space between the particles. For instance, fractures and joints in dense consolidated rocks like limestone can be as effective storage points for groundwater as the many small spaces between unconsolidated sand and gravel particles. Other dense rocks such as quartzite and granite with fewer fractures are virtually nonporous. Moreover, the more uniform the particles are in shape and size, the greater the porosity. For example, a box of ping-pong balls or light bulbs has a greater percentage of open space than a box filled with both ping-pong balls and light bulbs. Thus a mixture of sand and gravel may not be as porous as a formation of pure sand or gravel.

Though porosity is an important factor in determining permeability or the ability of materials to transmit fluids, highly porous materials are not necessarily highly permeable. In order to be permeable, a formation must not only have many open spaces between the particles composing it, those spaces must also be connected and sufficiently large to overcome the molecular attraction between water molecules and the particles themselves. Pouring water upon a clay surface and a sand surface demonstrates permeability. On the clay surface most of the water will run off, even though clays may have total porosities as high as 70 to 90 per cent. However, those spaces may be so small and unconnected that water cannot pass through them easily. The sandy surface, on the other hand, will absorb a large portion of the water, even though it has a much lower total porosity then the clay, because there are larger and more connected spaces between the sand particles.

The following table identifies the capacities of various consolidated and unconsolidated materials for holding and transmitting groundwater, based on their relative porosity and permeability.

a. Regional Differences in Aquifer Yield--these factors of porosity and permeability are important in determining the suitability of a region's groundwater resources for human use. Theoretically, there is groundwater beneath all areas, but some types of aquifers are more productive than others. Nearly all the groundwater pumped in the country comes from highly productive gravels and sands. As shown in Figure V-2 these unconsolidated deposits are found along watercourses, in flood plains, and in buried or abandoned river beds and valleys. Industrial areas in the Midwest and East depend upon such deposits, as does the San Joaquin Valley groundwater reservoir--one of the most productive aquifers in the country.

Table V-1. AQUIFER CAPACITY AND POTENTIAL YIELD

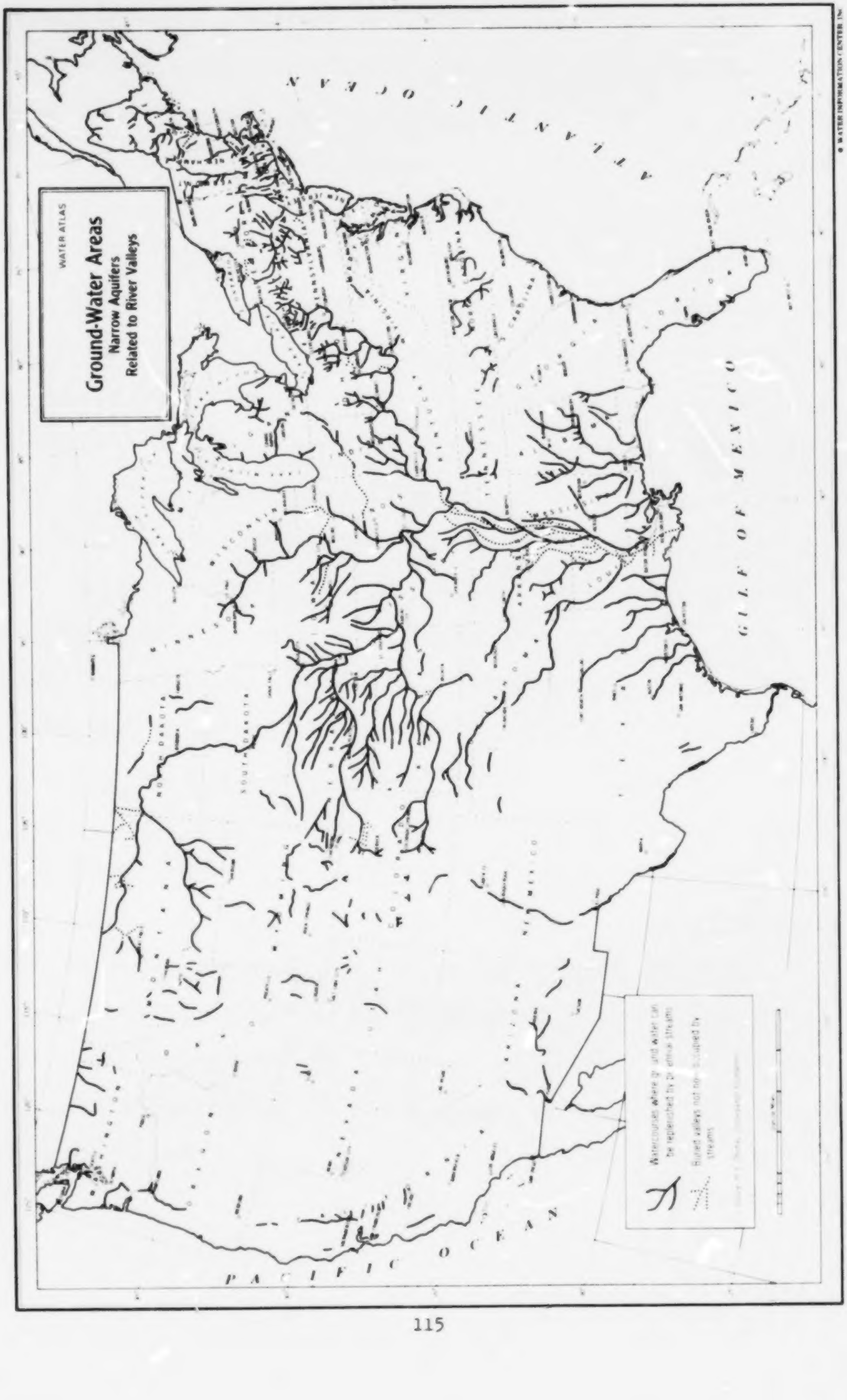
Unconsolidated Materials	Water Yield
coarse gravel	high yield
average to fine gravel	moderate yield
coarse sand	moderate yield
clay and silt	poor yield

Consolidated Materials	Water Yield
sandstone	high yield
limestone	moderate to high yield
quartzite	poor yield
granite	poor yield
shale	poor yield

Some unconsolidated materials such as clays, silt, and certain kinds of glacial deposits are porous, but not highly permeable and are relatively unproductive aquifers. Yet they are just below the surface of extensive areas of the country and supply limited amounts of water to many wells in rural areas.

Consolidated rocks, because of compaction and cementing materials holding the particles together, are generally unporous. However, fractures and joints increase porosity, and the property of some rocks, notably limestones, to be dissolved by water, creates many openings in the rock. It is in such soluble rocks that many of our well-known caverns, such as Mammoth Cave in Kentucky and Carlsbad Caverns in New Mexico, are found. Similar

Figure V-2[1]


WATER ATLAS
Ground-Water Areas
Narrow Aquifers
Related to River Valleys
Watercourses where ground water can be replenished by perennial streams
Buried valleys not now occupied by streams
ATLANTIC OCEAN
GULF OF MEXICO
PACIFIC OCEAN
NORTH DAKOTA
SOUTH DAKOTA
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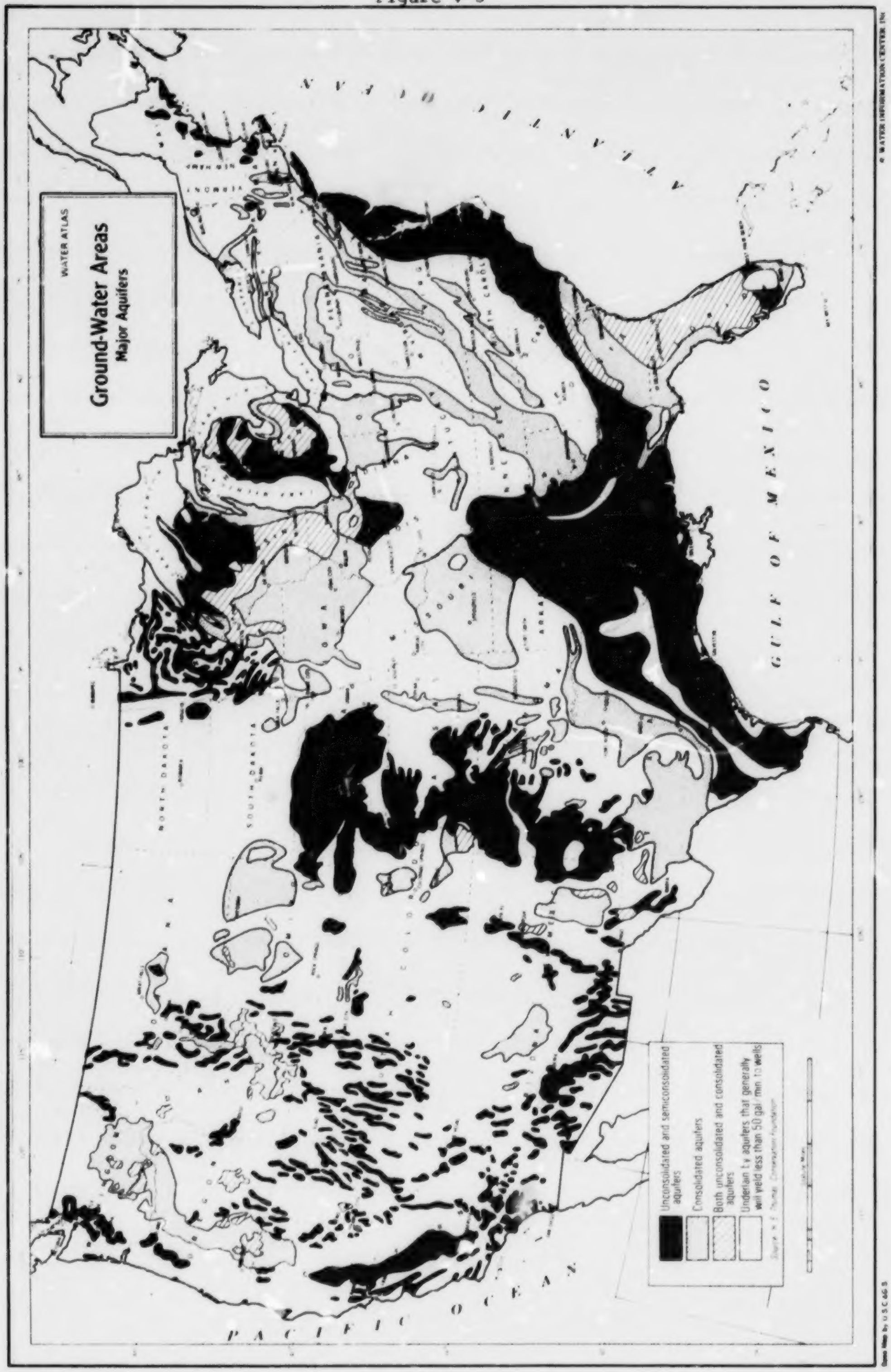
openings of varying size in limestone provide excellent groundwater reservoirs in central Tennessee, the Shenandoah Valley of Virginia and parts of Georgia, Kentucky, Florida, New Mexico, and Missouri. Gypsum beds in western Oklahoma are also filled with groundwater in cavities dissolved by water. Much of the groundwater in such soluble rocks is hard and alkaline, due to the calcium carbonate dissolved from the rock.

Other consolidated, nonwatersoluble rocks are not so highly productive aquifers. Basalt and some other volcanic rocks, which form plains underlying many parts of the Western states, are as permeable as limestone and produce many excellent wells. Sandstone and conglomerates are the consolidated counterparts of sand and gravel. The cementing material which holds these rocks together generally reduces porosity, and only those sandstones which are poorly compacted make productive aquifers. Crystalline and metamorphic rocks, formed by pressure or volcanic action, occur in mountainous regions, or in areas where mountains once were. Though they are very low in porosity, some are productive aquifers in humid areas where the rock has weathered into many smaller sizes filled with cracks and fractures.

Figure V-3 shows the occurrence of productive unconsolidated and consolidated aquifers in the United States.

b. Productive Yield of Aquifers--In many parts of the country groundwater is pumped out of these aquifers for use as drinking water or irrigation. Yet there are natural limits upon the amount of water which may be extracted from a given aquifer. Although many aquifers are replenished or recharged

Figure V-3[2]


WATER ATLAS
Ground-Water Areas
Major Aquifers
ATLANTIC OCEAN
GULF OF MEXICO
PACIFIC OCEAN
NORTH DAKOTA
SOUTH DAKOTA
IOWA
Unconsolidated and semiconsolidated aquifers
Consolidated aquifers
Both unconsolidated and consolidated aquifers
Underlain by aquifers that generally will yield less than 50 gal/min to wells
© WATER INFORMATION CENTER, INC.
Base Map by U.S.C.&G.S.

by seepage from adjacent underground formations, all aquifers depend, whether directly or indirectly, upon the infiltration of surface water, either from seepage from wetlands, lakes, and streams or the percolation of precipitation, for recharging the groundwater supply. The amount of water which enters the aquifer yearly, whether directly from percolation and surface water seepage or indirectly from adjacent formations, determines the amount of water that can be withdrawn annually without severely depleting the rereservoir. Thus perennial yield is determined by the average annual recharge. For example, some large aquifers in arid regions, particularly in the Southwest hold vast quantities of groundwater which has accumulated over a long time, but because very little water is added to the total reservoir capacity each year, the perennial yield is much less than that of a smaller aquifer with a higher recharge rate.

Annual average recharge is determined in large part by the climate of an area--the amount of water available from annual precipitation. But there are other factors as well. The soil must be permeable in order to allow surface water percolation into the aquifer, or there must be many bodies of surface water with permeable formations connecting them with aquifers. Vegetation on slopes can aid in the process of aquifer recharge by retarding runoff and allowing rain to percolate into the ground.

The yield of an aquifer to a well also depends on how rapidly water can move through the material that composes the aquifer. A well that is far away from a recharge area or a transmitting formation can yield water only as fast as the water moves through the aquifer. This ability of an of an aquifer to allow water to pass through its formation is dependent upon the permeability and porosity of the composing material as well as the slope of the aquifer underground. Thus for example, a highly porous and permeable aquifer of basalt, with a medium slope in a humid area, will be a productive source of groundwater.[3]

c. Depleting Aquifers--Failing to consider natural limits on recharge can result in the overuse and waste of the resource. Since the perennial yield or amount of water that can be taken from an aquifer annually is dependent upon the amount of water recharged into that aquifer, if more water is pumped out than is recharged, the level of the groundwater reservoir begins to fall. This practice, called mining, is a serious problem in areas like the arid Southwest, where the small annual recharge is greatly exceeded by water demands of communities and agriculture.

In areas where pumping exceeds aquifer recharge rates water conservation is important. If the water withdrawn from the aquifer were purified and then returned to the groundwater after it was used, the perennial yield could be maintained and in some cases increased. Instead much of the water withdrawn from the groundwater reservoir is sent down streams, creeks, and rivers.

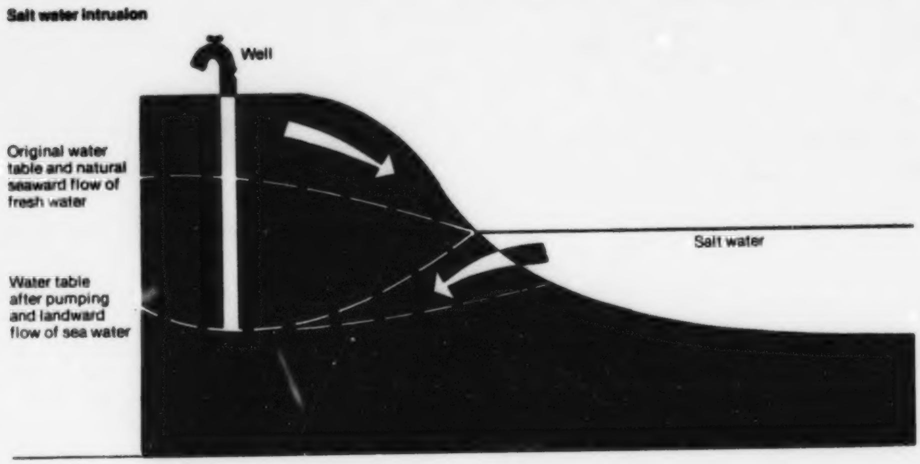
Mining can also cause the land surface to sink or subside. When the water is withdrawn from the aquifer, water from surrounding clay or silt layers is drawn into the more permeable aquifer, causing the clay to shrink as it dries out. The clay shrinkage may be substantial enough to cause subsidence at the surface. In the San Joaquin and Sacramento Valleys of California, for example, overpumping has caused the surface to sink by almost 14 feet.

d. Salt Water Intrusion--Although mining is generally associated with depletion of groundwater reserves, it can also result in pollution of aquifers.

Intrusion of salt water into aquifers is a significant pollution problem in coastal areas, especially in the aquifers of the coastal plain in the Gulf and Atlantic states. Here, where fresh groundwater aquifers are adjacent to saline groundwater, overpumping or mining of the freshwater results in intrusion of the salt water. When the freshwater reservoir is lowered, its natural flow towards the salt water (which acts as a barrier to salt water intrusion) is decreased or reversed, resulting in saline pollution of the freshwater well. (See figure V-4.) In such cases formerly productive wells must be abandoned until the freshwater reservoir is adequately replenished and reestablishes the natural boundary between fresh and salt water.

Saline pollution also occurs in areas where heavy irrigation demands for water decreases surface water reserves, thereby concentrating the amount of salts. Recycling of irrigation water by returning it to the aquifer for further use also concentrates salts in the groundwater as a result of repeated evaporation and circulation of the same water. As a result, formerly freshwater aquifers reach unusable levels of salinity.

Figure V-4[4]


Salt water intrusion
Well
Original water table and natural seaward flow of fresh water
Salt water
Water table after pumping and landward flow of sea water

e. Effects of Impervious Surfaces--In addition to overuse and waste of groundwater resources, human activities can also impede the process of groundwater recharge. Although many aquifers are recharged indirectly over a large area of land, from streams or subterranean waters, an aquifer may receive a substantial portion of its water from a relatively identifiable recharge area. Development upon such a recharge area and accompanying coverage with impervious surfaces will impair recharge to the underlying aquifer by physically sealing the recharge area to percolation, thereby decreasing recharge as well as increasing surface runoff.

Our groundwater resources are abundant sources of water for community and agricultural needs, but they are not endless. Overuse of them can result in many problems. In determining the amount of water that can be safely taken out of a given aquifer, we must be guided by the amount of water that is replaced, as well as the aquifer's ability to yield its stored water.[5]

2. Aquifers as Natural Filters for Groundwater

In the process of aquifer recharge , whether directly from the surface or indirectly through surrounding formations, some degree of purification occurs. Silt-laden runoff or organically rich effluents from septic tanks are filtered by the soil mantle through which the water percolates. Different soil types have different filtering properties; a coarse gravel will allow water to pass through rapidly and relatively unchanged, whereas a clayey soil slows the flow and filters out some contaminants. Of course a thick layer of any type of soil has a greater filtering capacity than a thin layer of the same material. However, even the most effective filtering action of the soil will not remove all contaminants. Salts, petroleum products, and other dissolved chemicals can pass relatively intact into an aquifer even after percolating through soil and transmitting formations.

The aquifer itself, depending on its composition, also acts as a partial filter to water passing through it. All aquifers can partially dispel pollutants and impurities by diluting them, but relatively permeable aquifers composed of small particles do additional filtering. As the groundwater moves slowly through such formations, usually at the rate of several inches to a few feet per day, impurities settle out into the transmitting material. However, highly permeable aquifers, through which groundwater moves as much as 100 feet per day, will do little filtering.

a. Susceptibility to Pollution--In general, however, the filtering ability of most aquifers and the process by which they are recharged insure that under natural conditions groundwater is relatively pure--especially in comparison with surface water supplies. Although there are aquifers that naturally contain brackish, highly mineralized, or saline waters, much groundwater can be pumped untreated from a well and used for human consumption. Yet improper land use is a threat to these reserves of pure water. Poorly planned waste disposal, urban runoff, heavy use of fertilizers, and other land-use practices can allow toxic chemicals, harmful bacteria, and other damaging substances to enter the groundwater reservoir.

The most crucial factor in determining the susceptibility of the aquifer to pollution from these sources is the location of the water table. The water table is the upper surface of soils, bedrock, or other material saturated by water. It is a variable line, fluctuating according to the quantity of the groundwater and the permeability of the materials around it. It generally follows the topography of the land, but it will fluctuate in its depth below the surface due to subsurface formation or forces which can change the underground flow. Since the water table rises and falls with precipitation patterns, it is generally higher in spring and fall and lower in the drier summer and winter months. In some places during wet seasons, the water table may lie on the surface of the ground in wet-weather ponds or flooded fields, while in drier seasons, and in other areas, it will be many feet beneath the surface.

The water table marks only the top line of groundwater, but it does not necessarily mark the presence of an aquifer, which may be many hundred feet beneath water-saturated soil. However, the water table does mark the occurrence of the water which eventually enters the aquifer. Thus an area where the water table is just beneath the surface, or where there is only a thin soil mantle, or where the soil is highly permeable, must be treated with care in terms of pollutants.

b. Land Use and the Pollution of Groundwater Reserves--Looking at the range of land-use activities that have traditionally caused problems of groundwater pollution will give an idea of how important the connection between water table and aquifer purity can be:

--placing septic tanks or cesspools below or near the water table allows sewage effluent to enter the groundwater without adequate filtration;

--leaks in sewer pipes connected to a centralized sewage system will have the same result;

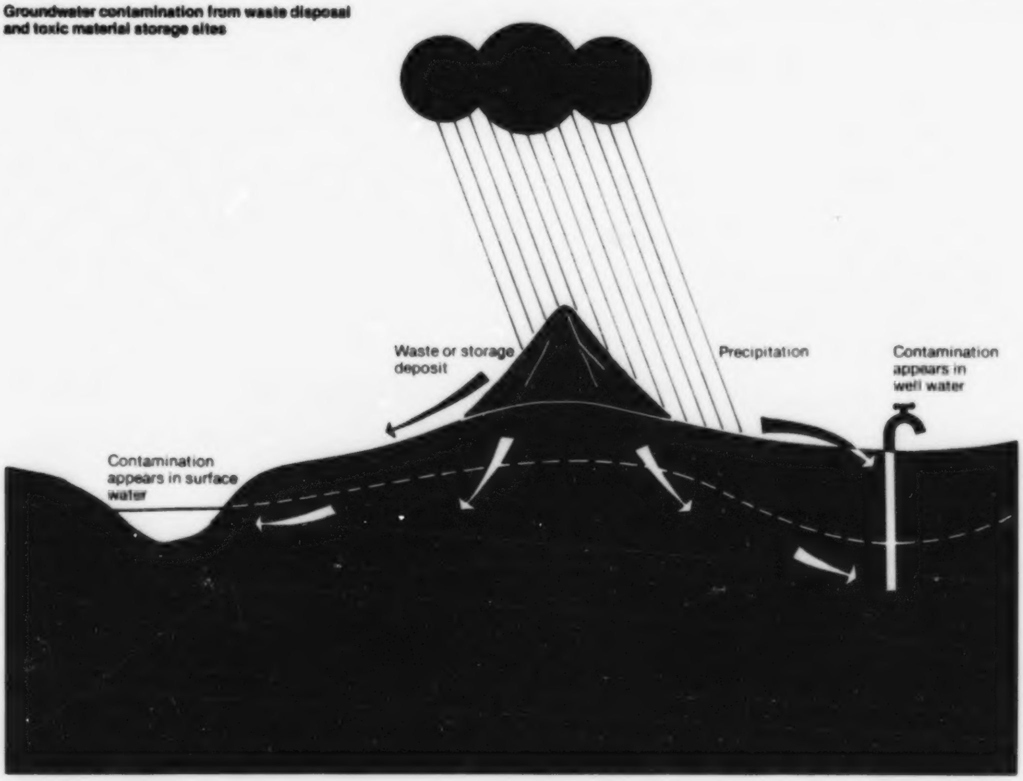
--agricultural activities such as cattle feedlots and intensive fertilization add nutrients and chemicals to the groundwater--especially where the water table is close to the surface or the soil exceptionally permeable;

--poorly constructed storage tanks for chemicals and petroleum products, oil spills at airports or industrial sites, and petroleum pipeline leaks can create similar hazards;

--excessive use of salt on highways can create saline pollution of groundwater resources.

The effects of these various sources of organic and chemical pollutants range from negligible to severe. In Nassau County, New York, a 180-square-mile groundwater area has been polluted with nitrates from fertilizers and septic systems. In the Nassau County town of Levittown, a relationship has been established between "blue babies," or megamtarlon, a condition of infants whose blood is deficient in oxygen-carrying hemoglobin, and nitrate pollution of groundwater. On the other hand, the danger of these land uses can be controlled. An example of this is sanitary landfill sites. They were originally designed to decrease air pollution from burning garbage, but they in turn can pose a hazard to groundwater resources. Rainwater percolating down through the garbage produces a highly concentrated, toxic substance called leachates, which moves downward to the groundwater. (See Figure V-5.) If the landfill site has been placed in an area where the bottom of the site is close to or actually touches the water table, then the potential drinking water mingles directly with wastes. Industrial wastes, such as mining wastes, are sometimes disposed of in the same way, and the results can be equally serious. This problem can be solved by either carefully sealing the site to prevent leachates from entering the groundwater or locating the site so that the leachates are at least partially filtered and diluted before they reach important groundwater resources.

Figure V-5


Groundwater contamination from waste disposal and toxic material storage sites
Waste or storage deposit
Precipitation
Contamination appears in well water
Contamination appears in surface water

The danger of pollution also depends on the type of aquifer. The relative ability of the groundwater to replenish and flush itself determines how crucial those potentially damaging land uses may be. If an aquifer --the permeable groundwater-carrying formation--is enclosed between two less permeable layers, it is likely to have a smaller area from which it can obtain fresh water. These aquifer recharge areas occur where the confined aquifer outcrops at the surface. This area may be extensive, but it also may encompass only several acres. The Edwards Aquifer in Texas is such a case, and the Texas Water Quality Board has decided that it is essential to curtail the use of private septic systems within the recharge area. This case is discussed in more detail later.

A final source of groundwater pollution is worth noting. That is subterranean waste disposal. Some industries dispose of liquid wastes by injecting them into the ground. Such deep-well injection is generally designed to deposit the wastes in salty or otherwise unusuable aquifers. However, construction or breaks in the wells have allowed toxic substances to pass into freshwater aquifers. Of course, such deep-well injection should not be allowed with highly permeable aquifers, such as cavernous limestones.

In order to insure the continued filtering functions of the process of groundwater recharge, we must exercise care in land-use decisions, especially those involving the use, storage, and transportation of chemicals and the disposal of wastes. Critical areas with high water tables, highly porous soils, a thin soil mantle, or with aquifer recharge areas should be identified and treated with special care.[6]

3. Aquifers Are Part of the Hydrologic Cycle

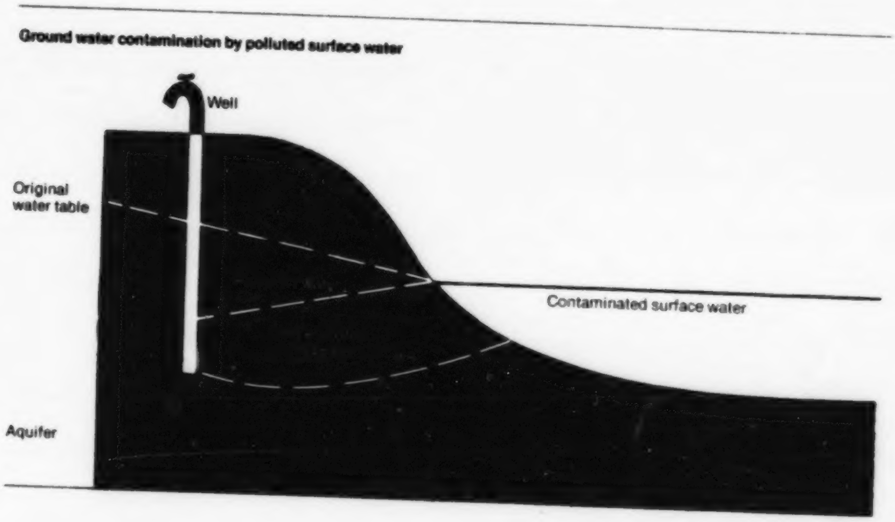
In addition to providing ample supplies of pure water for many communities, aquifers play an important part in the hydrologic cycle. Many aquifers occur near lakes and streams with which they are hydrologically interrelated. Many unconsolidated as well as consolidated aquifers depend upon surface water infiltration from lakes and streams for part of their recharge water. Aquifers can also provide important supplementary flow to streams, lakes, and wetlands during dry periods.

The particular case of waterclogged soils in some of the valleys and plains of the western mountains shows the relationship between surface and groundwater. These areas are thinly underlaid by highly permeable sands and gravels rich in groundwater resources, and abundant surface water in the rivers fed by melting snow in the mountains provides most of the region's water needs. The construction of large reservoirs to store the water from the spring melt has produced an unexpected problem. The stored water has infiltrated into the groundwater causing severe waterlogging of the soils.

Other areas have discovered the relationship between surface and groundwater through scarcity rather than unwanted abundance. In arid regions of the country, such as in the Southwest, many streams and creeks depend upon groundwater from aquifers for a large portion of their flow during dry seasons. In southern California and Arizona mining has so depleted groundwater reserves that some bodies of surface water have dried up or become polluted by the overconcentration of salts because of the limited amount of water available. Some areas of the Great Plains have similar problems where heavy demand for groundwater for irrigation has also depleted dependent streams. Less dramatic is the drying up of seasonal wetlands and springs in areas where heavy demand or increased impervious surfaces have lowered groundwater reservoirs. Such occurrences can deprive a community of valuable wildlife and recreational areas.

Just as depletion of groundwater reserves can be seen in the drying up of some streams and wetlands, the pollution of surface water can be seen in the lowered quality of groundwater, and vice versa. Highly permeable aquifers may seep polluted water into streams and creeks, and polluted river water can percolate directly into aquifers, bypassing the filter of the soil mantle or transmitting formations. (See Figure V-6.)

Figure V-6[7]


Ground water contamination by polluted surface water
Well
Original water table
Contaminated surface water
Aquifer

Our concern and interest with the quality and quantity of water in our lakes, streams, and wetlands must be supported by an equal concern with the quality and quantity of our groundwater resources. Since ground and surface water are part of the larger hydrologic cycle, protecting both these resources is necessary if we are to keep our water supplies pure and abundant.[8]

C. Current Practice in the Regulation of Aquifers

Groundwater resources are similar to energy resources; the government can either act to increase the supply or to curtail the consumption. Although groundwater has generally been treated as an unlimited resource, there is more experience in controlling consumption than guaranteeing the supply. It is taken for granted that city water supplies and individual wells will be checked by the health department; consequently, there is constant monitoring of the quality of water consumed. In terms of quantity of consumption, the history of local regulation is more spotted. Communities are more likely to institute user charges by metering water consumption than to use police powers. However, at times of shortages, it is common for communities to directly regulate the consumption of water by restricting uses such as watering lawns or car washing, or in areas where agriculture is dependent on irrigation, the counties and states regulate its use to prevent inequitable distribution.

It is undoubtedly wise to consider the consumption of groundwater resources even in noncrisis situations. A recent study of the wetlands of Dane County, Wisconsin, found that while the metropolitan area was not running out of water for its consumption, the increased urban use was causing damage to the wetlands that fed the lakes of the area. The lowering of the water table reduced the seepage into the wetlands , which in turn decreased the quantity of clean water entering the lakes. Thus the area's urban consumption of water was aggravating the problems of eutrophication in the lakes. The report recommends an active water conservation program as part of a general plan for maintaining the health of their wetlands.

Land-use controls can have some influence on water consumption changing the bias in our land-use controls for single-family detached housing with front, side, and backyard requirements that have ordained bluegrass lawns and discourage leaving native vegetation is one possibility. But the single most effective technique for the consumption aspect of groundwater is building in economic incentives for the wise use of water resources. This includes user charges from metering water or pumping taxes on individual wells.

The more appropriate area for the use of land-controls is on the side of renewing the resource--or on the side of supply instead of demand. A pollution tax on water recharge is impossible, since there is no way of measuring it; and while it might be possible to tax land in terms of the amount of permeable or impermeable surface, it would require a significant change in our taxing policies. On the other hand, much can be done by designing land-use controls so that they are sensitive to problems of groundwater.

Any regulation which helps maintain natural drainage patterns or reduces the amount of rate of water running off the land helps guarantee groundwater supplies. The regulations discussed in the preceeding chapter which protect streams or control runoff are important regulations for groundwater protection. Likewise the wetland protection discussed in the succeeding chapter can also benefit these supplies. But in addition, it is possible to design land-use controls for prime recharge areas. Much of this work is still in the initial stages of proposal and testing, but a great deal can be learned by reviewing some of the better studies and analyzing the few ordinances now in operation.

1. Water Quality Losses at the Local Level

Often wetlands ordinances, stream protection ordinances, and flood plain ordinances have the maintenance of aquifer recharge capacity as part of their stated purpose. Under some conditions, protecting these surface water systems may be adequate for maintaining groundwater supplies; however, two situations may make these measures inadequate. First, surface water systems may simply not be adequate for replacing groundwater--more water is used from the aquifer than the streams and wetlands recharge. Second, surface systems may be dependent on the groundwater for their own supplies rather than the reverse. In these cases it is necessary to obtain recharge through general surface percolation.

Such is the case of the Christina River Basin studied by the University of Delaware Water Resources Center.[9] The Delaware report examined two aquifers and their associated recharge areas in relationship to the water yield of the aquifers. This water yield is not only important because it provides water to the Christina River, but also because municipal water consumption in the basin is expected to outrun the natural yields of the aquifers. Consequently, from a public perspective, it was desirable to preserve the relatively inexpensive natural function of the recharge area of the two principal aquifers.

The primary recharge areas for both the Potomac and the Piedmont aquifers are relatively small, and the study identifies land-use alternatives for these recharge areas which would maintain present water yield from these aquifers. In order for the Potomac aquifer to produce its average yield of 13 million gallons per day, the aquifer recharge area must reflect one of the following land-use patterns:

1. "Allow development of 36 per cent of the recharge area (16.5 square miles) without conservation measures, but keep the remainder (29.5 square miles) in open space" or
2. "Zone the whole area for low density residential or a special zoning district . . . and make rezonings for more intensive use conditional on construction of conservation measures, in proportion to the increased runoff generation."

"Conservation measures" in the second alternative means such techniques as artificially injecting water into the aquifer by wells or catch basins. For the Piedmont aquifer the available unurbanized recharge area (1.7 square miles) is insufficient to maintain required yield even if that recharge area were entirely retained in open space. This aquifer would require both acquisition and some additional conservation measures in order for it to continue supplying water.

The study used a cost-benefit analysis to estimate the relative merits of aquifer protection and supplying municipal water through surface collection and purification. In this particular case, the value of the aquifer water supply did not justify direct purchase of the primary recharge areas. On the other hand, the system of aquifer protection through either partial purchase of development rights or low-density zoning plus conservation measures outweighed providing the water from an alternative source. The savings to the communities using the water would be substantial enough that they could afford to compensate the landholders and still come out ahead.

The study did find that the runoff-recharge ratio increased more rapidly than the percentage of land covered by impermeable surface. If 50 per cent of the land were covered substantially more than 50 per cent of the precipation would run off the land. Consequently, the conservation costs increased dramatically with increased development.

The Christina study is an excellent example of analyzing the alternatives available to public officials. Defining the functions and values of recharge areas relative to the water yield of the aquifers is a necessary first step in evaluating land-use regulations tailored for these areas. If recharge areas yield water of the quality and quantity necessary for human consumption, then the public's interest is obvious. When the recharge area is allowed to be developed as if it were just another piece of land, the impact falls with considerable economic weight upon the dependent population. While a later technological solution might correct the damage, it would be costly--at an ever-increasing rate. Thus, in the long run it pays to retain the natural functions by designing land-use regulations which both maintain recharge areas and allow some development.

Although the study does not design ordinances to regulate the Potomac aquifer recharge area, it identifies the regulatory options: either zone

64 per cent of the land as an open-space conservation area and allow the development on the rest, or zone the entire area for low density with the option of higher density if the developer provides conservation measures to compensate for the loss of natural recharge. The second option has the advantage of dividing the recharge responsibility equally among the landowners. The first would not treat all the same, so it might be necessary to compensate landowners who happen to fall into the open space area. Likewise, the second option has the attractive feature of increasing the owner's options with his land. Presumably if urban pressures continue to increase, it would be profitable to build at higher density and absorb the cost of providing some system of water conservation. Or new technology may become available that would reduce the costs of conservation, in which case it may become feasible to develop the land.

A variation of the low-density altenative has been implemented in Southampton Township on Long Island. This popular resort area is experiencing intense development pressures, and its natural water supply is limited almost entirely to the groundwater under the porous, sandy soils of the area. The most densely developed community in the township, Hampton Bays, has already experienced water shortages and has had to institute some rationing. With this clear increase in demand for water, Suffolk County studied the public water supply for the entire area and determined that the most important recharge area for these communities is the glacial moraine which runs down the middle of the island. Subsequently, the community's master plan designated this area as a Water Catchment-Residence area, and this policy was implemented in the zoning ordinances as a Country Residence Zone--CR-80 District. The statement of findings and purpose for this district is found in the master plan:

> Recognizing the critical nature of the community's fresh water supply, it will be necessary to assure the continued recharge of these ground waters by maximizing the amount of rain water which will reach it. For this reason, the porous moraine soils have been designated as Water Catchment-Residence area. The overall population density of persons per acre will be the lowest in the community. The total of these areas constitutes approximately 17,000 acres. . . .
>
> The suitability of the Carver and Plymouth Soils association found in the Ronkonkoma moraine for use as homesites, the accomodation of sewage effluent from homesites and the establishment and maintenance of lawns and landscaping is generally considered to be poor according to the Soils Conservation Service. They are rated as being severely limited for all three uses in areas having slopes in excess of 15 per cent. More particularly, sewage effluent may be expected to penetrate to the primary groundwater reservoir very rapidly due to the coarse texture of these soils. Collectively, these soil and slope related problems further sustain the premise that the moraine should not be committed to development as intense as that proposed in other areas of the community.

The ordinance itself specifies that there will be 80,000 square feet minimum per lot and per dwelling unit with the maximum lot coverage for both main and accessory buildings being 10 per cent. (See Table V-2 on page 136.)

The exact size of the lots (approximately two acres) and the coverage was decided by calculating the land necessary for recharge and the maximum number of septic systems the area could tolerate. The regulations limit impervious cover to approximately 1,700 acres of the 17,000. The option of allowing greater density or greater coverage with the provision of conservation measures was not considered because of the potential danger from more private sewage facilities. The possibility of providing centralized sewage treatment for the area was unlikely, and the recharge area could not support more septic systems.

Table V-2. Country Residence Districts-Dimensional Regulations

1.	Lot Area[a] - minimum - square feet	80,000
	- minimum per Dwelling Unit-sq. ft.	80,000
2.	Lot Coverage - Maximum Lot coverage by Main and Accessory Buildings - per cent	10
3.	Lot Width - Minimum - feet	175
4.	Height - Maximum	
	Stories	2-1/2
	Feet	35
5.	Yards - Principal Building - Minimum - feet	
	Front	80
	Side - minimum for one	30
	Side - total for both on interior lot	75
	Side - abutting side street on corner lot	80
	Rear -	100
6.	Yards - Accessory Buildings - Minimum - feet	
	Distance from street	90
	Distance from side and rear lot line	30

[a] Where public sewerage is not available, no lot shall be built upon which has insufficient space for a private sanitary waste disposal system, as determined by the Town and the Suffolk County Health Department.

Southampton, however, did attempt to increase the landowners' options in the zone by providing for transfer of development rights. These landowners could sell their development rights to developers in other areas of the township where greater density was allowed. Theoretically, with this system, even less of the area would be covered. The community, however, has not been able to implement this system. The questions of establishing what development rights can be sold, setting up a legal mechanism for their transfer, and drawing up guidelines for how the development transfer would effect other zoning districts have stalled any use of this technique.

The moraine area at the present moment has limited accessibility and is not under the intense development pressures of the ocean front; consequently the zone has not come under serious challenge.

The Christina suggestions and the Southampton ordinance are designed for the specific case of having a single important area of porous soils that acts as a prime recharge area, and the goal is to maximize rainwater percolation in this area. A very different style of ordinance was developed by Volusia County, Florida, to fit a different situation. Volusia County is dependent upon the Floridian aquifer for its water supply which in turn is dependent upon rainfall for its recharge. It is a large aquifer covering much of Florida, and at the present moment it is not being overpumped. However, with a continuation of the area's drought or heavy pumping by adjoining counties this situation could change and cause serious problems with the water supply and salt water intrusion into the aquifer. Studies done in the local area show that Volusia could protect its own portion of the aquifer by maintaining the saucer shaped catch-basins between a series of old dune ridges. This includes some 120 square miles of marshy land that during high water periods is completely inundated with water. At the present moment, the land is undeveloped and is used for some timber harvesting, and either agricultural or urban development would require extensive ditching and filling. Up to 1973 there were no land-use controls for this area.

This land is now protected by the Volusia County Water Recharge Ordinance. The stated purpose of this ordinance is "to protect the water resources of Volusia County, [and to] prevent the development or use of the land in the Potential Recharge Area in a manner tending to adversely affect the quality of water. . . ." The ordinance defines and maps the recharge area, and then requires permits for virtually any change in land use including construction, clearing, agriculture, demolition, refuse deposits, dredging or filling. The few exceptions are private recreation, agriculture which requires no landfill or drainage, and previously existing uses.

Because of the nature of this land, a simple low-density zone would not work. There are a few high areas that are buildable but they are not evenly spread across the area. In contrast to Southampton's situation, controls over impermeable surface are insufficient since alteration of the natural drainage system is a greater danger than covering the few areas of buildable land. Consequently, Volusia County has designed a much more comprehensive procedure by adapting the environmental impact statement to make it a regulatory mechanism. In order to obtain a permit, an applicant must provide information similar to an environmental impact statement. He must describe probable impact of the proposed action on the environment, any adverse impacts which cannot be avoided, and alternatives to the proposed action. This information is used to evaluate the proposed development by the Planning Department, Environmental Control Department, and Public Works Commission. The evaluations are submitted to the Department of Developmental Coordination and then to the County Council. The ordinance then provides that "no permit shall be issued unless and until the County Council has examined the application in light of the [environmental impact criteria] and determined that the . . . development as proposed would not have any adverse affect the environment of the Potential Water Recharge Area . . . and would not have any adverse effect with regards to the maintenance of the natural recharge." (The complete text is given at the end of this section.)

The Volusia ordinance is designed for flexibility; it is not designed to preclude development or use of the land, but instead to insure recharge close to that under natural conditions. It shifts the responsibility of protecting the groundwater onto the developer by requiring him to show that his specific development will not affect the quantity or quality of water entering the aquifer.

The ordinance is designed as an interim measure to protect the area until the state's St. John's Water Management District is set up and develops regulations for protecting the water supplies for the entire area. For this purpose, it is well designed. It gives the county government the necessary handle to become involved in land-use decisions in the area--which it had none before, and it sets up a negotiation process that does not preclude the landowners from using the land. The attractive feature of the ordinance is the way that it has adapted the environmental impact statement into a regulatory mechanism. The environmental impact procedure provides a preestablished mechanism that already has some refinement in methods and structure, which in turn makes the initial implementation easier. If, however, the ordinance is extended over a longer period of time, either to complement the water district work or to continue to fill a gap in regulation, then it may be necessary to establish more specific standards by which the developers can operate. This would also help clarify the administrative review process.

In contrast to Volusia, a study done for Dade County, Florida, approached the same problems in terms of use specification.[10] The natural conditions are similar to those of Volusia and they need to control development in the yet undeveloped portions of southern Dade County in order to insure the water supply for both Miami and the Everglades National Park.

While the Volusia ordinance depends upon identifying only the prime recharge area, this plan covers all the land in southern Dade County, and designates primary and secondary land for groundwater recharge, with different types of zones for each. Urban development would be concentrated into ridges of high ground that would not need dredging or filling and the rest of the land would be divided between an intensive agriculture zone with a limit density of one unit per acre, a recreation, agricultural zone with a limit of density of one unit to every five acres, and a recreational limited agricultural zone with a limit density of one unit to every ten acres. This would be supported with public service policies for supplying roads, schools, and public utilities. The plan essentially depends upon controlling urban expansion. This is a much more ambitious scheme, but it is also more difficult to implement, since it depends upon a comprehensive change in land-use. practices.

2. Regulating Biological and Chemical Pollution

Although both the Southampton and the Volusia ordinances are concerned primarily with maintaining the quantity of water available, they also deal with the quality of the water. Part of the intent of the large-lot zone established by Southampton is to minimize the impact of private septic systems on the groundwater quality, and the Volusia ordinance requires the County Council to consider the impact of development on water quality as well as water quantity. But their prime focus is on maintaining sufficient recharge. Under other conditions, a more appropriate focus may be the protection of water quality. In situations where there are rock croppings or fractures in the rocks, water quality can become the prime consideration , since surface water moves directly into the aquifer with little filtration. Two communities have attempted to deal directly with this form of groundwater degradation: San Antonio, Texas , and Amherst, Massachusetts.

Over a million people in southwest Texas are dependent on the Edwards aquifer for their water supply including the city of San Antonio. The aquifer is fed by large fractures, caverns, and other natural channels in the rock so that it is particularly sensitive to pollutants. Protection of the aquifer is complicated by the fact that the recharge area sprawls across seven counties in the region. Consequently, the Texas Water Quality Board has set up a special water district and designed special regulations to protect the resource.

The regulations essentially operate like a county zoning ordinance and at this point represent the most detailed specifications for protecting groundwater from contamination. The order from the Texas Water Quality Board maps the recharge areas in each county and then details special regulations for these areas. The order:

--requires wherever feasible that effluents be transported away from the recharge area. If this is not possible, then sewage disposal systems must meet strict effluent standards. In addition these facilities must be equipped with emergency power facilities, spare parts, and remote monitoring systems to protect against breakdown or malfunctioning. For regional sewage collection systems, there is a similar set of requirements concerning their construction and maintenance;

--forces licensing and inspection of all new private sewage systems, including septic systems, and registration of existing systems;

--bans feed lots, landfill disposal operations, pit privies, cesspools, and injection wells in the recharge area; and

--makes developers gain approval from the state board before new subdivisions can go in over the recharge area. The Board may require the developer to provide special facilities for sewage disposal, to clean streets frequently with a "vacuum-type" cleaner, to guarantee at least six inches of topsoil for lawns, to restrict the use of lawn fertilizers, to provide special construction of any facilities for the storage or transmission of hydrocarbon products, and to provide a groundwater monitoring system for the subdivision.

As with any ordinance with elaborate specification requirements, there is some concern that some of the requirements are too strict and others not strict enough. At the present moment the Texas Water Quality Board is refining these requirements. Even with state action, this regulation has not been easy to implement; and the rural counties feel that they are receiving the brunt of the regulation, while San Antonio is doing most of the polluting.

Amherst, Massachusetts, is attempting to institute similar regulations on the local level. In Amherst, the well fields are in a valley wetland supplied with clean water from the shallow aquifer which immediately surrounds it. While it is possible for the community to go to the next township to find additional water, the difficulty of developing intergovernmental agreements on the use of the water has made it obvious that they should also conserve the water resources within their own boundaries.

In part, preserving their water supply is a simple matter of preserving recharge areas from being sealed by buildings and roads. The prime recharge areas are characterized by deep sand and gravel, and these are also prime development sites. The sand and gravel base make building cheaper by reducing the costs of initial foundation construction and also lessening the chance of damage from frost during the winter.

The more critical issue, however, has been pollution entering the aquifer through these soils. As well as being good building sites, the porous soils, with their rapid percolation, appear to be good soils for septic systems, and these private waste systems are potentially dangerous to the municipal water supply. In addition, this particular community has other land-use problems that immediately threaten the water supply. The town's present landfill site is located on top of one of the aquifer recharge area; the general problem of leachates from the fill combined with the dumping of chemical wastes and salt-laden road snow at the site threaten one of the present wells with contamination. And finally there are a number of gasoline and fuel oil storage facilities on the recharge areas that pose a threat to the water supply either from leeking or normal spillage.

The town's selectmen have adopted a policy to protect the recharge areas, but at the present moment are still considering specific regulatory techniques. Their initial steps have been focused on the problems of contaminants. The system that has been recommended to them includes establishing a recharge zone which would limit and regulate activities that are particularly dangerous to the recharge of water. The following are the presently recommended restrictions on fuel storage:

> 7.401.3. Public Safety--Fire Department--Storage of Fuel in Mapped Aquifer Recharge Areas.
>
> The Board has expressed its concern for the protection of the aquifer recharge areas and has adopted policy statement to insure the protection of these areas, such statements having been codified under Section VIII dealing with natural resources. The Board hereby adopts the following specific statements to be included within the general framework of Public Safety--Fire Department as follows:
>
> 7.401.31. Within the aquifer recharge area the noncommercial storage of fuel is allowed, either in above-ground or below-ground storage in quantities of 550 gallons or less, to be in compliance with all applicable town specifications.

> 7.401.32. All fuel oil storage in excess of 550 gallons must be stored underground in fiberglass tanks in compliance with applicable town specifications and regardless of the provisions of section 7.401.2 above.
>
> 7.401.33. All fuel oil storage in excess of 10,000 gallons per site within the mapped aquifer recharge area is prohibited.
>
> 7.401.34. The noncommercial storage of gasoline in quantities of 500 gallons or less is allowed within the mapped aquifer recharge area, stored either above or below ground, in compliance with applicable town specifications.
>
> 7.401.35. All gasoline storage either commercial or noncommercial in excess of 500 gallons is prohibited within the mapped aquifer recharge areas.

These recommendations are part of a series of recommendations for handling the aquifer recharge problems. Most of the rest are provisions to deal with the specific problem of the landfill site: not renewing the lease of an auto parts company that uses the site for dumping hydrocarbons and battery acid, providing a chemical waste tank at the fill site, dumping the salted snow in the area where it would do the least damage, and setting up a system of monitoring wells around the landfill in order to determine pollution problems before they reached the city well field itself.

Many of these first recommendations are problem-solving in their orientation; they are designed to try to minimize the present hazards. While the aquifer recharge area is officially mapped, at this point it does not constitute a typical zoning district with a list of prohibited and permitted acts. Instead it is used to administer general ordinances as those above.

D. Developing a Local Regulatory Program

It makes sense for a community to have an active policy of maintaining the stability of its groundwater reserve--both quantity and quality. If communities use these resources for their water supply, there is an obvious self-interest,since the alternative supplies are likely to be more costly. But beyond this the policy is important since the groundwater supplies are so intimately connected with other natural systems, such as wetlands, lakes, and streams, that keeping the system as balanced as possible reduces both the dangers of flooding or droughts.

Groundwater, however, is a bewildering resource to regulate. Since both its boundaries and its functions are less obvious than other natural resources, it is more difficult to build general public support for its regulation. A landowner will know if he has a wetland on his land, but he is unlikely to know if he owns land that is a primary recharge area. Likewise, groundwater resources seem particularly plagued by problems of jurisdictional boundaries. At best it will be a county government protecting the interests of municipalities within its boundaries ; but, as with the Christina study, the critical recharge areas may not only be several counties away, it may be in another state. These jurisdictional problems are further complicated by the structure of local government. The concern for groundwater is split among numerous departments from the engineering department, the health department, the water commission, and on and on. All of these considerations make the political feasibility of regulation more questionable.

It is in part because of this political sensitivity that the communities which have attempted to institute regulatory programs have started with detailed technical studies. It is necessary to know the type of aquifer and the particular hazards to it, to map its primary recharge area and know the amount and rate of infiltration necessary to maintain its water yield, before one can begin regulating. This information will determine the style of local regulation. If the groundwater is recharged primarily through surface water areas such as streams and wetlands, then it is best to protect those areas; if the recharge area is small, then acquisition may be appropriate; if it comes from a relatively large area of porous soils, then low-density development would be the strategy. Much of the technical information may already be available through the work of the Soil Conservation Service or the United States Geological Survey, but it needs to be interpreted in terms of possible protection strategies.

A prime question the study should address is the extent that the groundwater can be protected in the immediate area,because it is here that action can proceed quickest. In many cases significant action can be taken , particularly at the county or township level. In the case of Amherst and Southampton,enough of the recharge area is within their jurisdiction that it is possible to implement programs at the local level. Amherst does not expect that its local well fields will support all of its future population, but clearly that preserving those eight million gallons a day reduces the problems of obtaining water from other jurisdictions. The interjurisdictional problems on the pumping end can be as complicated as conserving aquifer recharge. In the case of Volusia County, their groundwater is part of the much larger system of the Floridian aquifer, but preserving the recharge in the immediate area can maintain that section of the aquifer. Not all communities are that lucky, however; both the Christina and the Edwards conditions require some type of governmental arrangement. Still a community is in a better bargaining position if its own house is in order.

Another important part of this initial technical work is the actual mapping. The process of establishing a zoning district is a more precise type of mapping than hydrological maps. In the first case it is a matter of either falling inside or outside the district while in the second case it is drawing a line that generally indicates the gradient from one soil type to another. One possible solution to this problem is to use the system sometimes used by floodplain zoning. Drawing the known flood zone and then a second buffer zone around this. The regulatory requirements for the buffer area are less restrictive than in the flood plain itself, but more restrictive than in the areas further away from the flood plain. This double mapping more accurately reflects the natural conditions than a single line, but on the other hand it makes the ordinance structure more complicated. The other possibility is to draw the line in terms of best available information, and establish a system by which the map can be amended through field tests when there is a question about a particular site.

A final important part of this initial work has to be to determine the amount of recharge necessary and the land area over which it can be most effectively accomplished. If the regulatory strategy is to establish a recharge zone or a groundwater protection zone, then the report should identify the criteria for establishing the zone. This can be done by soil suitability slope alone or some combination of soil type and particular geological structures which make one land area more critical to recharge than another. The zone cannot be arbitrary. Equity requires that the landowners who are similarly situated be treated in the same manner, and that the burden of groundwater recharge be spread over all of the appropriate land area and not simply on a limited portion.

In designing a local regulatory program, one should balance regulatory considerations with other alternatives: either fee-simple purchase of the land (or some less-than-fee-simple purchase) or providing water through an alternative source, such as surface collection and purification. The acquisition route will be most appropriate in cases where the aquifer recharge is relatively small. In the case of a confined aquifer with a limited number of outcroppings, or a limited fractured zone that represents a particular hazard to the groundwater, this may be the most appropriate strategy. Although this limited recharge area is rare; still park and open space planning can partially alleviate recharge problems. In projecting the costs of the alternative--alternative sources of water, it should be remembered that this is only a partial solution to groundwater problems. While it will provide for urban water needs and could possibly also provide irrigation water for agriculture, it does not necessarily protect the rest of the system connected to groundwater. These may require additional conservation measures of artificially recharging the groundwater. Likewise this alternative has a number of hidden costs that should be considered. For example, if the water is coming from any distance, the hydrological cycle of another area will be disrupted for the sake of providing the water.

In most cases, however, the recharge area will be of a magnitude to make police-power regulation the most applicable. It will not be feasible or desirable to remove all the necessary land from development entirely by either fee-simple purchase or buying development easements. Or looking at it from another direction, the regulation will not have to be so prohibitive as to deny the owner reasonable use of the land.

In using a regulatory approach to groundwater protection, a community can either go the direction of establishing a specific groundwater protection zone or follow the more general policy of runoff controls. The first is more appropriate in cases of high permeability which cause problems. The recharge zone approach can more easily restrict activities that can seriously harm the supply, such as landfill sites, septic systems, fuel storage or the use of high-nitrate fertilizers within an area of fractures or high porosity. On the other hand, the general runoff regulations discussed in the earlier section on streams and creeks need a less sophisticated data base to implement. There may be some situations where runoff regulations can incorporate conditions to control pollutants. Leon County, Florida, is contemplating adding a water quality section to their erosion and runoff ordinance. The proposed change would require any development to provide facilities so that the first inch of any rain would either soak into the ground or be treated before it is released. This change is based on the assumption that the dirtiest water is the first inch (this also covers most normal rainstorms for the area), and that the soil mantel is such that it will be able to filter out most harmful substances since there is no serious problem with fertilizers and other chemical pollutants.

Taking either route--the special recharge zone or the runoff controls--groundwater protection should be done with some kind of performance standards. At the present moment there is a great deal of reserach in progress on sealing landfill sites, providing form more environmentally sound methods of storing fuel, and overcoming the problems of impermeable surface runoff by using new types of pavements, building artificial aquifer basins that would purify runoff before it is allowed to go back into the normal groundwater. The groundwater ordinances should not limit these possibilities by simply forbidding acts that may be okay if designed in the right ways.

There are several models for accomplishing this style of ordinance:

1. The first is the system suggested by the Christina study-- of delineating a basic low-density zone which will allow the necessary recharge by coverage requirements, but allowing the landowner the option of higher-density zoning if he provides conservation measures to ensure the same amount of recharge that would take place at the lower density. In order to keep some uniformity in the district, it would be necessary to use this system in conjunction with more traditional style of zoning concerning the mix of residential, industrial, and commercial.

2. The second option is illustrated by the Volusia ordinance, which could feasibly allow any use of the land that was compatible with the hydrological system of the aquifer. Instead of setting a base zoning of permitted use, this system operates entirely through permits for any development of the land or any changing of the contours of the land. In this case, the developer is required to provide detailed information on how his development fits with the objectives of the Groundwater Protection Districts, and a yea or nay is given on the basis of whether it adequately meets the objectives. This puts much heavier requirements on the administrative structure,since any change needs to go through review by the heads of the local departments, and the county council itself with all of the appropriate public hearings.

3. The final option can be seen in the erosion and sedimentation ordinances. These ordinances establish specific standards that a development has to meet. In the case of DeKalb County, Georgia,and Leon County, Florida, the runoff must be held to what it would be under natural conditions of the land. In the case of groundwater recharge, an ordinance could simply specify that any development had to maintain the percentage of runoff to infiltration at the same ratio as natural conditions or some fraction thereof. Then the individual builder could choose how he met this requirement. He could use a simple berm to hold the water until it soaked into the ground, or more elaborate systems of purifying the water and artificially recharging the aquifer depending on what was appropriate for that site and in the ways he wanted to balance out his own costs.

Presumably any of these options could also require that the recharge water met the federal water quality standards to ensure that the aquifer was not polluted. In this case, the community could either set up its own review of these plans through its engineering or zoning administration departments, or they could allow the developer to have a licensed hydrologist certify that the designed system would meet the ordinance standards.

In any of these systems, a community must realize that there will be administrative costs. But the only way to avoid such costs is not to allow development at all. In these kinds of tradeoffs, in particular, they require substantial amounts of administrative expertise. Not only does it require the abilities of a hydrologist along with the other personnel reviewing development proposals, it also requires field personnel to check installation and maintenance of water conservation systems once they are installed. Presumably, this ongoing expense to the community will be much less than finding alternative sources of water, but still it has to be considered and planned for when designing the regulations.

NOTES

1. Geraghty and Miller Inc., The Groundwater Environment (Port Washington, N.Y.; Geraghty and Miller Inc., 1972), p. 6a.

2. Ibid. p. 7a.

3. For a more detailed discussion of the properties of aquifers and their classification see the following sources:
Geraghty and Miller, Inc., op cit.;
Helene L. Baldwin and C.L. McGuiness, A Primer on Groundwater (Washington, D.C.: U.S. Govrernment Printing Office, 1963).

4. Geraghty and Miller Inc., Groundwater Contamination An Explanation of Its Causes and Effects (Port Washington, N.Y.: Geraghty and Miller Inc., 1972), p. 9.

5. The following source discusses overconsumption of groundwater and the consequences:
Robert F. Legget, Cities and Geology (New York: McGraw-Hill, 1973).

6. For a more detailed discussion of groundwater contamination see the following:
U.S. Environmental Protection Agency, Polluted Groundwater: Some Causes, Effects, Controls and Monitoring (Washington, D.C.: U.S. Printing Office, 1973);
Geraghty and Miller Inc., Groundwater Contamination. An Explanation of Its Causes and Effects (Port Washington, N.Y.: Geraghty and Miller Inc., 1972).

7. Geraghty and Miller, Inc., P. 9.

8. For a more detailed discussion of the hydrologic cycle and the role of groundwater see:
Helene L. Baldwin, op cit.;
Luna B. Leopold and Walter B. Langbein, A Primer on Water (Washington, D.C.: U.S. Government Printing Office, 1960).

9. Joachim Tourbier, Water Resources as a Basis for Comprehensive Planning and Development of the Christina River Basin (Newark, Del.: University of Delaware Water Resources Center, 1973).

10. Division of Applied Ecology, Center for Urban Studies, University of Miami, An Environmental Land Planning Study for South Dade County, Florida (Coral Gables: Universtiy of Florida Center for Urban Studies, 1971).

BIBLIOGRAPHY

Geraghty and Miller, Inc. Groundwater Contamination. An Explanation of its Causes and Effects. Port Washington, New York. 1972.

> A report aimed at a non-scientific audience that explains quite clearly the causes and kinds of groundwater contamination. It contains several good diagrams of how groundwater contaminated by a source can move to a well or other fresh water source. There is a section on governmental regulations concerning groundwater contamination.

Geraghty and Miller, Inc. The Groundwater Environment. Port Washington, New York. 1973.

> An excellent primer on groundwater for use by non-scientists. The report goes into the properties of soil and rock materials that contribute to the value of an aquifer, defines what an aquifer is, and explains how the amount of water that can be withdrawn from a well depends upon how much water is replenished to the aquifer that it taps. It includes a map of the major groundwater areas of the U.S.

Langbein, Walter B. and Luna B. Leopold. A Primer on Water. Washington, D.C., U.S. Geological Survey. 1960.

> A well illustrated introduction to the role of water on planet Earth. It begins by explaining the water cycle, how water moves from atmosphere to surface water flow. Some of the problems associated with water, flooding, sedimentation, erosion are described also. The second part of the primer is titled, Water Use and Development and discusses the fluctuating nature of the water supply and the problems that may be encountered as the demand for water increases. This is an excellent resource for those who require a simple but intelligent introduction to all aspects of water.

Pope, Dale E. Planning for Groundwater Protection: Amherst, Massachusetts: A Case Study of the Hydrogeologic Implications of Land Use on an Unconsolidated Aquifer. Amherst, Massachusetts. December 1972. 83 pp.

> This is a Masters thesis prepared in conjunction with the Town of Amherst. It is perhaps unique in its attempt to bridge the gap between scientist and planners on a relatively small scale problem. It offers an overview of the water quality of the aquifer

aquifer and proposes land-use policies compatible with the adequate functioning of the aquifer, with specific recommendations for various town bodies.

Tourbier, Joachim. Water Resources as a Basis for Comprehensive Planning and Development of the Christina River Basin. Water Resources Center, University of Delaware, Newark, Delaware. 1973.

This is a technical report covering the completion of the first phase of a study of the Christina River Basin in northern Delaware. In the study the Basin was used as a model area to analyze techniques for the long-range protection of water quality and water supply in areas undergoing urban development. It describes a natural resource inventory that was made, discusses refinement of the site class concept for protection of water resources and protection measures and their costs. It has a very fine section on groundwater and recommends some innovative methods of protecting groundwater.

DATA NEEDS AND TECHNICAL ASSISTANCE

The principal data need with regard to groundwater is to find the water table and to find out how it fluctuates during the years. Knowing how far below the land surface the groundwater reservoir begins is critical in deciding what kinds of land use are reasonable or unreasonable in an area. Groundwater flow patterns are also an important data requirement. Which way does groundwater flow; towards the town well or away from it? If an aquifer is primarily recharged at an outcrop it will be necessary to identify that recharge area.

All of these issues are part of the hydrology of any area. The USGS and state geological surveys staffs include groundwater hydrologists, geologists, and other groundwater experts. Although most of the major aquifers of the country have been identified, at the local level very few maps exist that identify local aquifers, recharge areas, and water table levels. The state geological surveys on a matching funds basis with USGS have field people who can answer some of your questions about groundwater. Because there has not been a regional collection of local groundwater information by USGS you will probably fare better by contacting the state geological survey directly. (See Appendix H, page 518). They make up any necessary arrangements with USGS. The well drillers in your community may have more specific information on local groundwater than even the state geological survey but may want to charge you for their services. It's worth a try.

A SELECTED LIST OF COMMUNITIES WITH AQUIFER REGULATIONS

Amherst, Massachusetts
Office of the Town Planner
Town Hall
Amherst, Massachusetts 01002

Austin, Texas
Texas Water Quality Board
P.O. Box 13246
Capitol Station
Austin, Texas 78711

Southampton, New York
Planning Board
Southampton, New York 11968

Volusia County, Florida
County Planning Department
De Land, Florida 32720

APPENDIX V-a

BE IT ORDAINED BY THE COUNTY COUNCIL OF VOLUSIA COUNTY, FLORIDA:

SECTION I: Findings of Fact:

In adopting this ordinance the County Council of Volusia County hereby finds the following facts to be true:

(A) Volusia County is a unique hydrological entity in that an insignificant portion of the water supply for the entire County is derived from sources outside the County. On the other hand, a certain amount of water leaves Volusia County through rivers and streams and other water courses as well as the Clastic and Floridan Aquifers. Volusia County is almost totally dependent upon rainfall within the County for its entire water supply. Water is supplied to users in Volusia County from wells driven into the Floridan Aquifer. As water is used, the aquifer is replenished or "recharged" primarily from rainfall which ultimately finds its way to the Floridan Aquifer.

(B) The area described in Exhibit "A", hereinafter described as "Potential Recharge Area" is essential to the water quantity and quality of Volusia County for the reasons more specifically stated hereafter. Water recharge occurs throughout Volusia County; however, the Potential Recharge Area has the greatest potential for recharge of the Volusia County water supplies as water is drawn from the Floridan Aquifer. Within the Potential Recharge Area, as the level of water in the Floridan Aquifer is reduced through use, the rejected recharge which currently occurs in the area would be decreased by capture of such water, thus increasing the amount of water available for use.

(C) In those areas of Volusia County currently identified as the best defined areas for recharge to the Floridan Aquifers, the recharge ability cannot be increased. This is due to the fact that these areas, particularly the DeLand Ridge, the Rima Ridge and the Atlantic Coastal Ridge generally are accepting the maximum amount of rainfall available. Continued development of these areas will decrease the recharge capability because of less natural area available to absorb rainfall and an increase in the volume and speed of surface water run-offs which in turn increases the amount of water lost to rivers and streams and due to evapo-transpiration.

(D) Control of development within the Potential Recharge Area is imperative for the following reasons:

(1) The previously mentioned ridges are currently the areas of greatest development and development potential in Volusia County, resulting in adverse effects on their future potentials as areas of recharge to the Floridan Aquifer.

(2) The greatest amount of fresh water is available from the Floridan Aquifer within the Potential Recharge Area with a minimum danger of salt water intrusion into the water supplies of Volusia County.

(3) Land within the Potential Recharge Area is currently undeveloped and essentially undevelopable due to the existing surface and subsurface water conditions. Developments for other than limited agricultural and timber production uses could only occur with the

use of substantial drainage and significant alterations of the present hydrological and geological conditions. Such alterations would adversely affect the recharge potential of the Potential Recharge Area by decreasing the capability of the area to provide continuous recharge to the Floridan Aquifer.

(4) The natural vegetation within the Potential Recharge Area as well as the interaction of surface water areas with the Clastic and Floridan Aquifers provides the superior filtration of waters recharging the Floridan Aquifer, reducing the amount of natural and man-made pollutants reaching the Floridan Aquifer. Such filtration is being lost in the present Potential Recharge Area due to development.

(5) If the Potential Recharge Area is sufficiently controlled and generally preserved in its natural state, it will assure the maintenance of a water recharge system sufficient to supply the projected needs of the entire County for water well beyond the projected population increases through the year 2,000. Uncontrolled development of the Potential Recharge Area, combined with the continued development of all other areas of Volusia County will seriously impair the water supply of Volusia County by significantly reducing recharge capabilities to the Floridan Aquifer as use of water continually increases. Such a situation could ultimately result in increased salt water intrusion in various areas of the Floridan Aquifer as well as potential future water shortage.

(6) Any uncontrolled drainage or alteration of the natural movement of surface water through construction of roads, fill of land, excavation and similar alterations would adversely affect the relationship between the surface waters and the recharge of the Floridan Aquifer which makes the Potential Recharge Area the optimum area for potential recharge of the Volusia County water supply system.

(E) While certain types of development will have no adverse effects on the beneficial aspects of the Potential Recharge Area, it may actually enhance positive qualities, uncontrolled development will give rise to substantial destruction of the potential abilities of this area to sustain adequate, quality water supplies for Volusia County for the reasons more specifically set forth heretofore.

SECTION II: Purpose. Historically, water is a thing which belongs to no one, and the use of which belongs to all, and is an entity apart from the land. Water movement, particularly as applicable to the Potential Recharge Areas, includes rainfall, retention drainage, underground water course movement, randon seepage and movement in and above the ground water course. The entire water system constitutes a vital part of the natural environment of both Volusia County and the State of Florida. In light of the foregoing findings of fact, in view of the supportive findings set forth in that certain report of the United States Geological Survey entitled, "Evaluation of the Quantity and Quality of Water Resources of Volusia County, Florida", and subsequent investigations of the United States Geological Survey and the Volusia County Environmental Control Department, as reported to the County Council at a public hearing held on the 21st day of June 1973, by reason of the mandate of the people of the State of

Florida as set forth in Article III, Section 7, of the Florida Constitution (1968 Revision) providing that it shall be the policy of the State to conserve and protect its natural resources, and by reason of the mandate of the people of Volusia County as set forth in Article II, Section 2.2, of Volusia County Charter, providing that the County shall prevent the development or use of land or commission of other acts by persons, partnerships, or corporations which will tend to destroy or have a substantially adverse effect on the environment of any established residential or business area within the County, it is hereby declared that this ordinance is necessary for the protection of the water supply of Volusia County.

"The purpose of this ordinance is to protect the water resources of Volusia County, prevent the development or use of land in the Potential Recharge Area in a manner tending to adversely affect the quantity of water within Volusia County or tending to destroy or have a substantially adverse effect on the environment of the County by virtue of pollution of the air, land or water by foreign substances, including noxious liquids, gasses or solid wastes or pollution by virtue of the creation of potentially harmful conditions including the creation on unnecessary injurious heat, noise or odor and preserve the aesthetic qualities of the County in order to enhance the overall development of the County and the proper planned promotion of agriculture, tourism and appropriate residential, commercial and industrial development within Volusia County. It is intended by this Council that this ordinance be interpreted liberally in view of the paramount public interest involved in the preservation of the Potential Recharge Area."

SECTION III: Short Title

This ordinance shall be known and may be cited as "The Potential Water Recharge Area Preservation Ordinance of Volusia County."

SECTION IV: Definitions

1. "Action" means any application for a permit under this ordinance or any development or use encompassed within the jurisdiction of this ordinance.

2. "Development Permit" or "Permit" includes any building permit, zoning permit, plat approval or rezoning, certification, variance, or other action having the effect of permitting development as hereinafter defined.

3. "Development" means the carrying out of any building, agricultural or mining operation or the making of any material change in the use or appearance of any structure or land, and the dividing of land into two or more parcels. The following activities or uses shall be taken, for the purposes of this ordinance, to involve development as defined herein.

    (A) Any construction, reconstruction, alteration of the size, or material change in the external appearance of a structure on land.

    (B) Any change in the intensity of use of land, such as an increase in the number of dwelling units in a structure or on land, or a material increase in the number of businesses, manufacturing establishments, offices, and dwelling units, including mobile homes, campers, and recreational vehicles, in a structure or on land.

    (C) Any agricultural use of land including, but not limited to, the use of of land in horticulture, floriculture, viticulture, forestry, dairy, livestock, poultry, bee keeping, pisciculture and all forms of farm products and farm production.

(D) The commencement of drilling, except to obtain soil samples, or the commencement of mining, or excavation on a parcel of land.

(E) Demolition of a structure.

(F) Clearing of land as an adjunct of construction for agricultural, private, residential, commercial or industrial use.

(G) Deposit of refuse, solid or liquid waste, or fill on a parcel of land.

(H) Construction, excavation or fill operations relating to the creation of any road or street or any drainage canal.

4. "Parcel of Land" means any quantity of land capable of being described with such definitedness that its location and boundaries may be established, which is designated by its owner or developer as land to be used or developed as a unit, or which has been used or developed as a unit.

5. "Person" means an individual, corporation governmental agency, business trust, estate, trust, partnership, association, two or more persons having a joint or common interest, or any other legal entity.

6. "Potential Recharge Area" means that area of real propety located in Volusia County as described in Exhibit "A" which is attached hereto and incorporated herein as part of this ordinance.

7. "Planning Department" means the Planning Department of Volusia County or the planning staff that has been designated by the County Council as a planning staff for Volusia County.

SECTION V: Prohibition

(A) Except as otherwise provided in Section X, in the Potential Recharge Area as herein defined, and as described in Exhibit "A" attached hereto and made a part hereof, no person may erect any permanent structure, including the placement of mobile homes, nor shall any person engage in the development of land, whether for residential purposes or otherwise, for any commercial, agricultural or industrial pursuit, whether temporary or permanent, unless such person first obtain a use permit from the County Council in the manner set forth in this ordinance.

(B) Within six months from the effective date of this ordinance all persons engaged in any activities set forth in paragraph (A) above shall submit to the Development Coordination Department a statement indicating the nature and extent of activities being carried on. Such statement shall include the information required in Section VI(A) of this ordinance.

SECTION VI: Application for Permit

(A) All applications for a use permit shall be made to the Department of Development Coordination in the manner and form prescribed by said department. The application shall include a description of the proposed action, use or development, including information and technical data adequate to allow for a careful assessment of the application in light of the guidelines set forth in Section VII of this ordinance. Where relevant, maps and other information shall be provided upon request from any department or agency examining the application.

(B) Upon receipt of an application for a use permit pursuant to this ordinance the Department of Development Coordination shall submit copies of such application to the Department of Environmental Control, the Planning Department, the Department of Public Works and such other County, State or Federal departments or agencies it deems should be advised of the proposed action for review and comment.

(C) Within ninety (90) days after receipt of an application, the aforementioned departments shall submit written reports to the Director of the Department of Development Coordination, which report shall include recommendations from each department. In preparing such reports each department shall take into account the guidelines set forth in Section VII of this ordinance. All departments and agencies may cooperate and submit a single, comprehensive report.

(D) Upon receipt of the reports, the Director of Development Coordination shall forthwith place the matter on the agenda for County Council consideration, and shall notify the applicant when the matter will be considered by the Council.

(E) Whenever the County Council determines that an application is one which would generate substantial Public interest or could cause a significant change in the Potential Recharge Area, the Council may call for a public hearing with at least fifteen (15) days public notice, published once in a newspaper of general circulation in the County.

(F) Each department may request the assistance of any other department or agency of any local government, the government of Volusia County, or any State or Federal Department or agency. The department may also require such additional information from the applicant as it deems is reasonably necessary in order to furnish the County Council with a complete report.

(G) After July 1st, 1973, whenever an application is submitted which, but for the fact that it affects only Volusia County, would be a development of regional impact pursuant to the criteria established in accordance with Chapter 380, Florida Statutes, such application shall be accompanied by an environmental impact statement which shall be prepared in accordance with the criteria established by the National Council on Environmental Quality pursuant to the National Environmental Policy Act of 1969 (Public Law 91-190, January 1, 1970). All such applications shall be subject to a public hearing in accordance with sub-paragraph (E) above.

SECTION VII: Guidelines

In determining whether a permit should be granted, the County Council shall apply the following guidelines:

(A) The probable impact of the proposed action on the environment, including impact on ecological systems such as wildlife, fish and marine life. Both primary and secondary significant consequences for the environment should be examined. For example, the implications, if any, of the action on population distribution or concentration should be estimated and an assessment made of the effect of any possible changes in population pattern upon the Potential Recharge Area, including land use, water and public services in the Potential Recharge Area.

(B) Any probable adverse environmental effects which cannot be avoided (such as water or air pollution, undesirable land use patterns, increased water runoff, damage to life systems, urban congestion, threat to health or other consequences adverse to the goals and the purposes of this ordinance).

(C) Alternatives to the proposed action, use or development. In considering alternatives, the Council shall attempt to assure that the purposes of this act are complied with and that the action or use proposed is best fitted to meet these purposes. A rigorous exploration and objective evaluation of alternative action that might avoid some or all of the adverse environmental effects is essential. Efficient analysis of such alternatives and their costs and impact on the environment of the Potential Recharge Area should be examined in order not to foreclose prematurely options which might have less detrimental effects.

(D) The relationship between local, short term uses of man's environment, and the maintenance and enhancement of the long-term productivity of the Potential Recharge Area. This will require the County Council to assess the actions for cumulative and long-term effects from the prospective that each generation is the trustee of the environment for succeeding generations.

(E) Any irreversible and irretrievable commitments of resources, particularly water, which would be involved in the proposed action, use or development, should it be implemented. The County Council should identify the extent to which the action curtails the range of beneficial uses of the environment of the Potential Recharge Area. Compatibility of the proposed use with existing uses in the Potential Recharge Area, and compatibility with the zoning and land use planning for all lands which would be affected by the proposed use.

(F) The effects and compatibility of the use or development or action with regard to the matters set forth in the findings of fact under Section I of this ordinance.

SECTION VIII: Grant of Permit, Alteration of Use

(A) No permit shall be issued unless and until the County Council has examined the application in light of the foregoing criteria and determined that the use, activity, or development as proposed would not adversely affect the environment of the Potential Water Recharge Area, would be in harmony with the purposes of this ordinance and would not have any adverse effect with regards to the findings of fact set forth in Section I of this ordinance.

(B) In granting a use permit, the County Council may prescribe appropriate conditions and safeguards in conformity with this ordinance and, where applicable, may prescribe a reasonable time within which the action permitted is required to be begun, completed or terminated. Violation of such conditions, safeguards or time limits, when made a part of the terms under which the use permit is granted, shall be deemed a violation of this ordinance.

(C) The permit issued shall specify the use permitted and any conditions set forth by the Council to assure the intent and standards of this ordinance are complied with. Where applicable, plans and specifications shall be attached to and made a part of the use permitted. The permit shall state that the granting of the use permit under this ordinance does not waive the requirements of any other County, State or Federal law, ordinance or regulation.

(D) Whenever any person has obtained a permit and thereafter desires to alter the use in any way from the use as proposed and authorized, such person shall make application for a new permit.

SECTION IX: Issuance of Development Permits

No development permit, as defined herein shall be issued within the Potential Recharge Area until such time as the applicant therefor has secured a use permit pursuant to the provisions of this ordinance.

SECTION X: Exceptions

Exceptions: The following uses are excepted from the provisions of this ordinance:

(A) Any parcel of land may be used for private recreational purposes, such as hiking, camping, hunting or fishing, without a use permit, when no change in the zoning classification of the property, conditional use or special exception is required for such use.

(B) Any agricultural use as defined in this ordinance shall be permitted without a Use Permit, when no roads or drainage canals or ditches are constructed subsequent to the effective date of this ordinance which would have the effect of permanently impounding, obstructing or diverting surface or subsurface waters. Nothing in this Section shall be construed as prohibiting the construction of irrigation ditches, temporary canals, plowing of land and similar uses which are ordinarily a normal part of agricultural operations unless undertaken for the sole or predominat purpose of impounding or obstructing surface waters, nor shall this Section be construed as prohibiting the construction of temporary roads and drainage canals incidental thereto, which roads are constructed solely for the purpose of inspection, harvesting or planting of forestry or agricultural crops, when such roads are ordinary and incidental to a forestry or agricultural operation.

(C) Any use which was in existence as of the effective date of this ordinance shall be permitted to continue indefinitely without a use permit, provided that no new roads or drainage canals or ditches shall be constructed as accesory to such use except in accordance with the provisions of this ordinance, and provided further that the requirements of Section V(B) of this ordinance are complied with. Nothing in this Section shall be construed to permit the construction of a residential structure or the placement of a mobile home on an individual parcel of land upon the grounds that said parcel was purchased for the purpose of development, as defined by this ordinance, prior to the effective date of this ordinance, without meeting the requirements for a permit as provided in this ordinance. Nothing herein, however, shall be construed to deny or prohibit the addition to an existing structure or its appurtenances or any accessory uses, provided that a notice of intent to expand such structure, appurtenance or accessory use is filed with the Development Coordination Department.

No part of this ordinance shall be construed to prevent the doing of any act necessary to prevent the harm to or destruction of real or personal property as a result of a present emergency such as fire, infestation by insects or other pests, or flood hazards resulting from heavy rains or hurricanes, when the propety is in imminent peril and the necessity of obtaining a permit is impractical and would cause undue hardship in the protection of the property

SECTION XI: Applicability to Incorporated Municipalities

This ordinance shall be applicable throughout the area described in Exhibit "A" including any incorporated towns or municipalities whether now in existence or hereafter created.

SECTION XII: Penalties and Enforcement

(A) Any person, whether an owner, lessee, principal, agent, employee or otherwise, who violates this ordinance or causes or participates in a violation shall be guilty of a misdemeanor and shall be punished by a fine not to exceed five hundred dollars ($500.00) or by imprisonment in the County jail for a period not to exceed sixty (60) days, or by both such fine and imprisonment. Each day upon which a person is in violation of this ordinance, shall constitute a separate offense hereunder.

(B) In addition to any other remedies, whether civil or criminal the violation of this ordinance may be restrained by injunction, including a mandatory injunction, and otherwise abated in any manner provided by law. It is hereby declared by this County Council that the violation of this ordinance is a hazard to public health, safety, and the general welfare, and is therefore a public nuisance.

SECTION XIII: Severance Provisions

If any part of this ordinance is held to be unconstitutional it shall be construed to have been the legislative intent to pass this ordinance without such unconstitutional portion, and the remainder of this ordinance shall be deemed and held to be valid as if such portion had not been included herein. If this ordinance, or any provision hereof, is held to be inapplicable to any person, group of persons, property, kind of property, circumstances, or set of circumstances, such holding shall not affect the applicability hereof to any other persons, property or circumstances.

SECTION XIV: Effective Date

A certified copy of this ordinance shall be filed with the Office of the Secretary of State by the Clerk of the Council within ten (10) days after enactment, and this ordinance shall take effect upon receipt of the official acknowledgment of that office that said ordinance has been filed.

SECTION VI

WETLANDS

A. Introduction

We have come a long way from thinking of wetlands as the breeding grounds for disease. Yet the tendency to see marshes and bogs as wasteland has produced the major theme in America's management of wetlands: the conversion of these habitats to other and supposedly better uses.

So-called "reclamation" of wetlands has been public policy for a hundred years. In 1850 the federal government was providing "Swamp Land Grants" to enable states to reclaim the "swamp land in their limits." When a state sold the land the proceeds were to be used "exclusively as far as necessary to the reclamation of said lands." Later the Federal Swamp Land Acts authorized the draining and filling of 65 million acres of wetlands in the 1800s. The policy has continued into the 20th century. In the 1920s and 30s the marshes and bogs of Iowa, Missouri, Illinois, Indiana, Ohio, Michigan and Wisconsin had been reduced to 10 per cent of their earlier range and acreage. Since World War II the wet prairies of Minnesota and the Dakotas have been drained extensively. Nearly 350,000 acres, or 25 per cent of that region's waterfowl-producing potholes , are gone.[1]

The most severe changes have occurred in the midwestern states, but the potential for conversion is national--particularly in the South and along the Atlantic coast. A United States Department of the Interior report of 1967 shows that 7.1 per cent of the coastal wetlands have been lost and 23 per cent severely modified. California alone has lost 67 per cent of its coastal wetlands. Overall, it is estimated that in the past 100 years the American wetlands have been reduced to 70 million acres, slightly more than half the original acreage estimated at 127 million acres.[2] Nevertheless, every state with significant wetlands is still experiencing pressure for the conversion of these lands to either agricultural or urban uses.

Land developed for increased agricultural production has accounted for much of this loss, but the more recent phenomenon of urbanization has taken its toll.

Urban conversion of wetlands occurs because real estate value is not influenced by the value of wetlands. An individual is unlikely to pay for a lake's natural filtering system or the nesting sites for herons, cranes, and other waterfowl. House and Home pointed out the potential of wetlands in April 1958:

> Some of these are in areas close to town that have been passed over while higher land all around has skyrocketed in price. Yet the marshy land can sometimes be bought and filled in for much less than the cost of surrounding land.[3]

Wetlands are the builder's dream of cheap land. There is no doubt that real estate values are one of the major causes of wetland destruction. California's wetland inventory in 1958, for example, was down to 500,000 acres from an estimated two million in less crowded days.[4] The cheap land image of wetlands works at all levels of the real estate market--cheap land for industrial development, solid waste disposal, and shopping centers. The greater the increase in land values from urbanization, the greater the impetus to take advantage of the low market price of wetlands.

There is one more turn of this economic screw. Wetlands not only suffer from the cataclysmic changes of dredge and fill; they also suffer from less drastic, everyday uses that go along on their borders and cause an incremental loss of quality. The housing development sitting on the hill above a marsh dumps increased runoff, silt, fertilizers, and other byproducts of urban living into the marsh. Similarly, the incremental effects of agriculture can destroy a marsh or bog. Fertilizers leach into the wetlands and plowing increases the silt flow. The people on the hill then experience the tragedy of the commons: they located there because they liked the open space, the access to rivers and lakes, and the variety of wildlife,but their actions destroy what they want.

Society has not found out what the actual credits and debits of development of its wetland resources really are. Though there has been little systematic work in evaluating the consequences of converting wetlands to other uses, bits and pieces of evidence indicate that the benefits are not without liabilities. It has been shown, for example, that the peat soil of wetlands is not always good farmland. Wetlands are low-lying areas subject to early frosts, and since the peat releases nutrients too slowly and too unevenly to provide fertile soil, it ultimately requires more fertilizer than other farmland. As a consequence drained land has previously ended up in soil banks rather than in production. Likewise many converted wetlands have not proved to be good home sites. The canals of the new Venices in California and Florida have quickly become choked with algae, leaving homes sitting on the banks of lagoons that resemble open sewers more than fresh delightful canals.

Although these problems remain unresolved, there has been a significant shift in both public attitude and public policy since the early

1960s. Where the older laws were devoted to protecting wetlands only as a corollary to the protection of fish and wildlife (Migratory Bird Conservation Act, 1929; Wildlife Restoration Act, 1934; Fish Restoration and Management Act, 1950), recent legislation and policy statements are focused upon the wetlands themselves as the resource to be protected, preserved, and restored (Estuarine Areas Act, 1972; Coastal Zone Management Act, 1972). Likewise, in April 1973, the Environmental Protection Agency announced a new policy to actively protect and preserve the nation's wetlands--the marshes, swamps, bogs and other low-lying areas that during some period of the year are covered in part by natural non-flood waters. The agency outlined four specific policy goals in support of this general agency stance:

1. To minimize alterations in the quantity or quality of the natural flow of water which nourishes wetlands and to protect them from adverse dredging or filling practices, solid-waste management practices, siltation or the addition of pesticides, salts or toxic materials arising from nonpoint-source wastes or through construction activities, and to prevent violation of applicable water quality standards.
2. Not to grant Federal funds for construction of municipal waste water treatment facilities that may interfere with the existing wetland ecosystem except where no alternative of lesser environmental damage is found feasible.
3. To consult with the Department of Interior in determining the probable impact of pollution-abatement programs on fish and wildlife in the wetlands.
4. To recommend a public hearing in the event of a projected significant adverse environmental impact.[5]

While these policies remain very general, they do represent a significant change in the federal government position. The Army Corps of Engineers developed a similar set of guidelines in April, 1974 under its authority from the Rivers and Harbor Act.

During the past five years, state and local governments have also begun many programs that specifically address wetland protection. Most of the states along the Pacific and Atlantic coasts, and Michigan on the Great Lakes, have passed legislation protecting wetlands. The major effort has been to obtain state control of dredging and filling of wetlands; in most cases these activities now require a state permit. While this legislation is recent and it is difficult to assess how well the states are using the permit systems, most state governments feel that the rate of wetland destruction has been slowed. Similar systems of wetland protection have also been instituted by municipal and county governments. Many of the local programs have been developed in response to states mandating greater wetland protection, but they tend to be more inclusive--developing general development control rather than simply restricting dredge and fill activities. These programs are described in detail later in this section.

B. The Public Purpose and Wetland Ecology

Wetlands are defined as a transitional between dry land and open water. They are areas of low topography, poor drainage, and standing water. Though we know when we are knee deep in water and when we are on dry land, the area in between is more difficult to recognize. This difficulty is primarily due to seasonal and yearly variations in the borders of wetlands. Waterlogged land in the spring may be dry through most of the summer and fall, and wetlands during years of extensive rainfall may be more extensive than during years of drought.

Though it is difficult to produce a universally accepted definition of exactly where wetlands end and other lands begin, wetlands are generally classified by their predominant water depth, the vegetation they support, and whether their waters are fresh or saline. Wetlands also vary according to climate, with marked differences in vegetation from north to south. Table VI-1 lists the various types of wetlands according to these factors, along with the most common forms of disturbance. It is based on the classification of the U.S. Fish and Wildlife Service, which is used to describe waterfowl habitats.

Analyzing a community's wetlands in terms of these ecological types is important, since it gives a better picture of the local resources being considered. Sedge meadows, for example, are often overlooked when considering a wetlands program because they may look more like grasslands than wetlands, but they are strategically important for their filtering and water storage capabilities. Likewise, certain types of wetlands may represent an extremely rare biological resource for an area. Bogs, for example, are relatively rare in the plain states and will support pitcher plants, sundews and other flora that are not found elsewhere in the region. In this case they can have value for their uniqueness.

Whatever their specific local value, wetlands do have a set of common natural functions that make valuable resources for society. The resource values of wetlands can be summarized as follows:

1. Wetlands affect the quality of water. Aquatic plants change inorganic nutrients into organic material, storing it in their leaves or in the peat, which is composed of their remains. The stems, leaves, and roots of these plants also slow the flow of water through a wetland, allowing the silt to settle out, as well as catching some of it themselves. Thus the removal of wetlands causes faster runoff of dirtier water.

   Consequently wetlands protect the downstream or offshore water resources of the community from siltation and pollution.

Table VI-1. WETLANDS

WETLAND TYPE	REGION OF LARGEST ACREAGE	REPRESENTATIVE VEGETATION (NORTH)	REPRESENTATIVE VEGETATION (SOUTH)
INLAND FRESH			
Seasonally Flooded Basins or Flats	mississippi north	varies with flood duration, lowland hardwood trees, smartweed, wild millet, fall panicum, tealgrass, chufa, cyperus	same
Inland Fresh Meadows (Sedge Meadow)	atlantic south mississippi north	carex, rushes, redtop, reedgrasses, mannagrasses, prairie cordgrass, mints	cordgrasses, paspalums, breakrushes
Inland Shallow Fresh Marshes	atlantic south	reed, whitetop, rice cutgrass, carex, giant burreed, bulrushes, spikerushes, cattail, arrowheads, pickerel weed	maidencane, sawgrass, arrowhead, pickerel weed, rushes, cattails
Inland Deep Fresh Marshes	central north atlantic south	cattails, reeds, bulrushes, wild rice, spikerushes, in open areas: pondweeds, naiads, coontail, watermilfoil, duckweed, water lily	many of the same species, plus water hyacinth and water primrose in some areas
Inland Open Fresh Water	mississippi north	pondweeds, naiads, wild celery, coontail, watermilfoil, muskgrasses, lilies, spatterdocks	similar species, plus water hyacinth
Shrub Swamps	mississippi north	alders, willows, buttonbush, dogwood, swamp-privet, usually along sluggish streams	same
Wooded Swamps	atlantic south	tamarack, arborvitae, black spruce, balsam, red maple, black ash, northwest: western hemlock, red alder, willows and thick mosses	water oak, overcup oak, tupelo gum, swamp black gum, cypress
Bogs	atlantic south mississippi north	leather leaf, labrador tea, cranberries, carex, cottongrass, sphagnum moss, black spruce, tamarack, insectivorous plants	cyrilla, persea, gordonia, sweetbay, pond-pine, Virginia chainfern, insectivorous plants
INLAND SALINE			
Inland Saline Flats	pacific south	sparse seablite, saltgrass, nevada bulrush, saltbush, burro-weed	same
Inland Saline Marshes	pacific south	same	alkali or hardstem bulrushes, wigeongrass, sago pondweed
Inland Open Saline Water	pacific north pacific south	sago pondweed, wigeongrass, muskgrass	same
COASTAL FRESH			
Coastal Shallow Fresh Marshes	mississippi south	redgrass, big cordgrass, carex, spikerush, sawgrass, cattails, arrowheads, smartweed	similar with maidencane
Coastal Deep Fresh Marshes	mississippi south	cattails, wild rice, pickerelweed, giant cutgrass, spatterdock, pondweeds	similar with water hyacinth and water lettuce
Coastal Open Fresh Water	mississippi south	similar, excluding water hyacinth	scarce in turbid waters: pondweeds, naiads, wild celery, coontail, water milfoils, muskgrasses, water hyacinth
COASTAL SALINE			
Coastal Salt Flats	central south	sparse vegetation: glassworts, seablite saltgrass	similar with saltflat grass and saltwort
Coastal Salt Meadow	atlantic north atlantic south	saltmeadow cordgrass, saltgrass, blackrush, olney threesquare, saltmarsh fleabane, pacific coast: carex, hairgrass, jaumea	same
Irregularly Flooded Salt Marshes	atlantic south	dominantly needlerush	same
Regularly Flooded Salt Marshes	atlantic south mississippi south	atlantic and gulf coasts: salt marsh cordgrass pacific coast: alkali bulrush, glasswort, arrowgrass open areas: wigeongrass, eelgrass or sago pondweed	same
Sounds and Bays	central south	eelgrass, wigeongrass, sago pondweed, muskgrass	southeast: shoalgrass, manateegrass, turtlegrass
Mangrove Swamps	florida only		much red mangrove and some black mangrove

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2. Wetlands also influence the quantity of water. They act to retain water during dry periods and hold it back during floods, thus keeping the water table high and relatively stable. One acre of marsh is capable of absorbing or holding 300,00 gallons of water, and thus helps protect the community against flooding and drought. Coastal wetlands also absorb storm impact.

3. Wetlands are important resources for overall environmental health and diversity. They provide essential breeding, nesting, resting, and feeding grounds and predator-escape cover for myraid forms of fish and wildlife. The presence of water is also attractive to many upland birds and animals. Since it is here that the food webs of land and water are most intimately connected, wetlands are important for supporting a wide variety of plants and animals. These factors have the social value of providing general environmental health; recreational, research, and educational maintaining the economic functions of trapping and fishing; and adding to the aesthetics of the community.

In many ways wetlands present the classic case for public regulation. Most of their assets are public goods; if they are provided for one member of society they are provided for all of them. Consequently, the use values of wetlands are not considered through the regular system of the land market. An individual cannot sell his marsh filtering function on the market, nor can he price his groundwater protection system and sell it to others. Such values may play some role in land-use decisions, but they will generally be overweighed by the development potential of the land. Therefore, it becomes important for the government to regulate these common resource functions of wetlands. There is a logical series of steps a community should follow in developing a regulatory program for its wetlands.

1. A community must recognize the range of use values that wetlands offer. Then it must

2. act on a policy level. First, are those values important to us so that we want to insure that they continue? And then, if yes, what are the specific values we are most interested in? Defining these policy goals will make a difference in

3. Choosing the style of regulation. If the policy is to guarantee that the community's residents will not suddenly find their homes sitting in a foot of water, there will be one set of regulatory procedures. If the goal is to maintain wetlands as wild areas so that the community has the redwing blackbirds it enjoys now or that it will continue to see the wild swans pass through in the spring, then it must develop a different wetland program.

Whatever common resource values the community decides that it wants to maintain, it is first necessary to understand how the wetlands function so that the regulatory program can achieve those goals. The closer the regulatory program reflects the ecological nature of the wetlands, the more effective it will be.

The following discussion of wetlands ecology and the way it serves the public interest focuses primarily on inland wetlands, since these have received less attention than coastal wetlands. A recent publication of The Conservation Foundation, Coastal Ecosystems, by John Clark, is an excellent study of the ecology and functions of saltwater wetlands.[6] Though much of what follows applies to all wetlands, there is an additional section at the end on the special functions of coastal wetlands.

2. Wetlands Protect Water Quality

Wetlands affect water quality by trapping and storing in plant tissue the nutrients from upland runoff and serving as a settling basin for silt from upland erosion. This natural filtering function of wetlands can be seriously damaged, however, by poor land-use practices. Since every wetland has a unique tolerance for filtering runoff from the uplands around it, development in the upland can create more nutrient and sediment inflow than the marsh is able to absorb. Moreover, development in and around the fringe of the marsh itself can destroy its ecological health and thus its filtering ability.

Because of wetlands' contribution to water quality and their vulnerability to heavy, nutrient and sediment rich runoff, they fall within the regulatory function of local government. The broad objectives of social, political, and economic well being that allow communities to do multipurpose community-wide zoning and subdivision restriction are designed to promote the most suitable use of land, as well as to protect, conserve, and promote the orderly development of land and water resources. Protecting water quality is part of this mission. Since wetlands are an important link in the entire hydrological system, the community's interest in larger bodies of water requires it to be interested in the wetlands. When a community has to close its beaches because of dangerous bacteria, it knows the wetland's assimilative capacity is overloaded. Thus, there are also long-range health and safety considerations in a wetlands program.

Quite often planning documents cite these use values as the important functions of wetlands. It is true that the removal of wetlands by dredging or filling will have an immediate impact on the water quality of streams and lakes below them in the watershed system. These documents also suggest that by preserving the marshes the community will have an effective anti-pollution device. Yet this assertion may not necessarily be true, especially if wetlands are treated as a bottomless catch basin.

When nutrients are added to an aquatic ecosystem, the physical and biological results are called eutrophication. It is a natural process which occurs in all wetlands to a greater or lesser extent, depending on local availability of nutrients, the rate at which they enter the system, and the rate at which they leave. Eutrophication is a process closely associated with the aging or filling-in of lakes. As the nutrient levels increase, the water supports greater plant life, which in turn builds the organic bottom of the water body. Wetlands, because of their greater plant population and their tendency to hold water longer so that it is not flushed downstream as quickly, trap these nutrients, which are then stored as muck and peat deposits. Under normal conditions these deposits do not build up as rapidly as is often supposed. It can take thousands of years to add a few feet to the bottom of a bog.

On the other hand, human activities can telescope the long, gradual process of eutrophication from centuries to a few decades or even years. Sediments and nutrients from upland development can overload and damage the natural system, turning the wetland into a settling basin of polluted and unpleasant smelling water.

Usually at advanced stages, eutrophication is an unpleasant process from man's point of view. It produces smelly algae blooms or dense growths of waterweeds, and it depletes the oxygen levels in the water when the plants start to respire or decompose. On a hot, windless night, the rate of chemical activity in a small marsh is high, no light is available for photosynthesis and little oxygen is added to the surface. If the plants are respiring or decomposing at the time, the oxygen level may become very low and cause fish kill.

Since a marsh is relatively small and shallow, it is less able to handle the nutrients from a given watershed than would a larger or deeper lake.

A wetland has a larger relative surface area exposed to sunlight, where algae and submerged, floating, or emergent plants can grow. Since the bottom mud is warmer, even when shaded, chemical processes are faster than in a deep lake. Likewise, when agitated by winds, the bottom layer of nutrients are stirred up and released into the water. All of these conditions tend to make marshes and other wetlands quite sensitive to nutrient inputs.

While wetlands operate as nutrient filters, they can be easily overloaded and thus destroyed. This is exactly what happens with man-caused eutrophication. Through increased runoff and nutrients from fertilizers and urban development, the entire process of eutrophication is speeded up. It is estimated that it can be 100 times as fast as the natural process. Consequently a marsh area that would have acted as an important nutrient filter for 1,000 years may only function that way for 10 years once it is overloaded.

Treating wetlands as settling basins for overland runoff has many of the same qualifications that apply to their function as nutrient traps. Removing wetlands will immediately affect adjacent waters by increasing the flow of dirtier water into them. Wetlands act to hold down turbidity--the amount of suspended particles in water--by slowing the upland runoff as it flows through the tangle of wetland plant roots and systems. The resulting reduction in the force of water flow and the natural catch basin formed by plant roots allows some sediment to settle out of the water. Though overland runoff is a natural process which in itself is not harmful to wetlands, if the speed of runoff or the erodibility of the upland soil is increased, then wetlands will be overloaded in the same manner they can be by nutrient inputs.

A simple experiment can make this process clear to a planning commission meeting, a citizen hearing, or the city council. Take two gallon jars, one filled with water and silt from a marsh heavily influenced by erosion, and the other with water and organic bottom material from a healthy marsh. Then stir them up and leave them sitting on a table. In ten or 15 minutes the organic matter will settle out and the water will be clear; however, most of the silt will still be in suspension. As the meeting goes on into the night, the silt will still not have settled out. While it takes the organic matter a few minutes to clear, it will take the silt two-and-a-half to three days before it will clear entirely. It can be pointed out that this experiment was performed under ideal conditions, since a wetland is relatively shallow and fish and wind will be constantly stirring up the silt bottom.

Turbidity seriously reduces water quality in marshes and other wetlands. Suspended particles dramatically reduce the amount of light reaching the bottom and thus give a competitive advantage to particular plant species. Top growing plants such as algae or submerged plants with low light requirements will dominate. Once again man is faced with smelly algae blooms and oxygen depletion. These suspended particles also influence the animal life in the marsh. Fish which depend on sight for feeding--which include all the desirable game fish--will be seriously affected. The scavenger fish, such as carp and suckers, which are not sight feeders, will be at an advantage. This change in fish population also exacerbates the siltation problem. Scavenger fish are constantly rummaging through the bottom as they feed and thus keep the silt in suspension.

In these ways agricultural, as well as suburban development, by increasing siltation in a wetland's watershed, overload and degrade the wetland's natural filtering system. An experiment conducted in Wisconsin shows how development accelerates erosion and siltation. The amount of erosion which occurs from corn fields in 50 years would take 15,000 years under fallow land; 27,400 years under forest; and 171,500 years under grasslands. Since the farmer has the incentive of preserving as much of the soil in his fields as he can, we can speculate about the even higher rate of erosion from construction sites where no such incentive exists. Even a one-time silting from construction can have a long-term impact on marsh ecology since silt is slowly flushed out of wetlands and is constantly stirred up by wind and scavenger fish.

Our public policy protecting wetlands must remember our ability to accelerate the eutrophication and siltation of wetlands. If the goal is clean water, we must do more than prevent the dredging and filling of wetlands because they filter nutrients and sediments. We cannot treat them as bottomless settling basins or nutrient traps. We must minimize nutrient inputs so that wetlands will continue to act as filters as long as possible, and we must control the amount of upland erosion so that wetlands will continue to trap sediments from runoff. And by regulating nutrient and sediment flow, we can maintain healthy marshes with diverse plant and animal communities.[7]

2. Marshes and the Stability of Water Supply

Wetlands have value to a community because they moderate extremes in water supply. They retain water during dry periods and hold it back during floods, thus keeping the water table high and relatively stable. Anyone who has struggled to get petunias to grow in a window box understands an important part of how wetlands perform this function. Peat, the organic material deposited at the bottom of a wetland as plants die, can hold and maintain large quantities of water. By adding this organic material to window box soil, it can better withstand the drying effects of the sun and wind, and thus provide the necessary moisture for the plants. This absorptive property of the peat makes wetlands natural sponges which reduce the risks of flooding and drought.

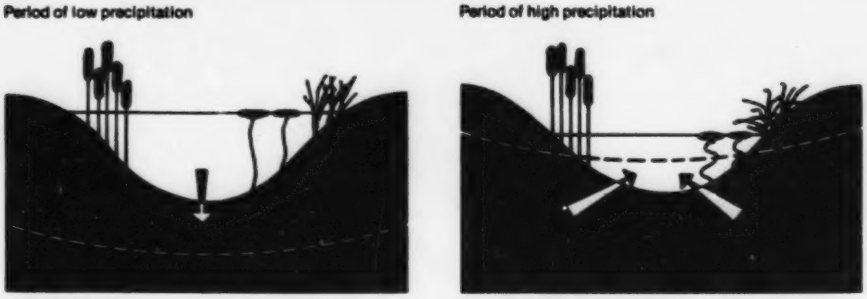
The complete relationship between marshes and groundwater hydrology is more complicated. In this respect wetlands may have one of three general characteristics:

1. The wetland is a recharge area for groundwater. (See Figure VI-1.) Some portion of the wetland's basin extends below and connects with the water table, the top surface of groundwater.

   During periods of heavy precipitation, much of the runoff on the uplands is moving too rapidly to be absorbed by the soil and cannot enter the groundwater supply. Since wetlands slow the flow and hold the water, additional amounts of it are able to replenish the underground supplies. Then, during dry periods, the peat of the wetlands will continue to release water, thus keeping the groundwater supply relatively stable.

   The levels of water in the two systems, however, will not be equal. After a hard rain, especially if overland flow occurs, water will be higher in the wetlands. Surface water will percolate into the groundwater until both levels are about the same. After a drought, the water level is down in the wetland due to evaporation, but may be replenished somewhat by groundwater. Eventually, however, the groundwater becomes low enough so that the wet-

Figure VI-1



Wetlands as groundwater discharge and groundwater recharge areas

Water collected and stored in the wetland filters down to *recharge* the groundwater

Groundwater is *discharged* to the wetland

land may dry up. This process is often the most dramatic with sedge meadows or shallow marshes. These areas are "temporary" wetlands--with standing water during rains that dry up during other periods. Because of their semidry hummocks of vegetation, they have greater absorption capacity during periods of precipitation and then depend upon contact with the groundwater during periods of drought. Since these are also the easiest areas to drain or fill, they are most subject to destruction, but damaging them means that one is also draining the groundwater supply.

2. The wetland is a groundwater discharge. (See Figure VI-1.) Although this wetland type may receive water from overland flow, it also obtains water from streams and seepages. Such wetlands are most important in the arid regions of the West since other land will be quickly dried by evaporation, but they are also important elsewhere. Because they are fed from clean underground water, they are likely to support different plant populations and be of higher quality than wetlands which are dependent on overland flow for their water. And many plants depend on the stable water level maintained by groundwater flow.

3. The wetland is "perched" above the water table, but its basin floor is sealed by a layer of impermeable clay. In this case, there is minimal linkage between the wetland and the water table. The wetland simply acts as a catch basin for overland flow. During periods of heavy precipitation the basin will fill until it overflows, sending the rest of the water downstream or into

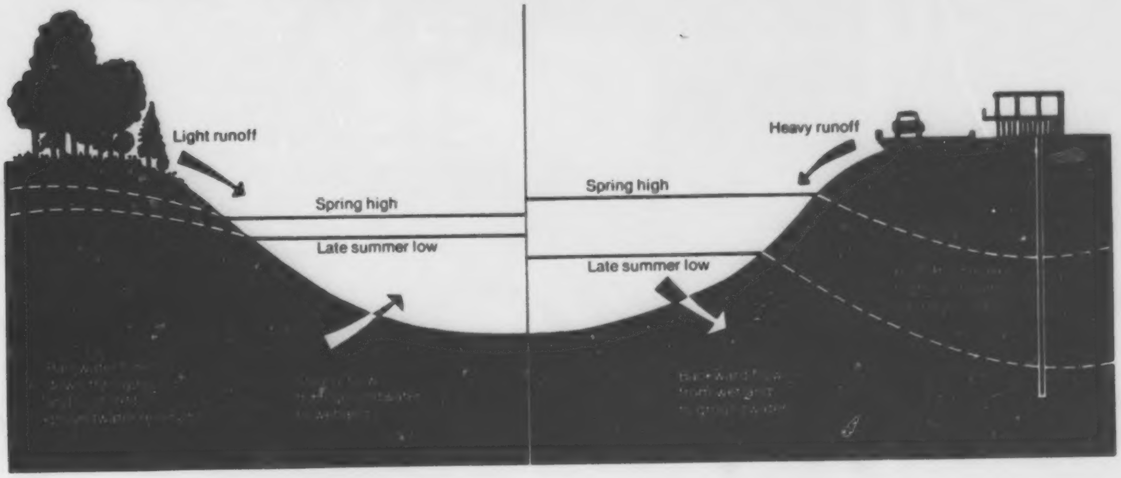
> an adjacent lake. In this way it functions like a small dam by reducing the total amount of water in lower areas of the watershed, thereby reducing flood risk. During periods of drought, it loses water through evaporation like the uplands, but at a slower rate because of soil and plant conditions, and thus acts as a water hole for farm animals or wildlife.

The cycling of water in wetlands is important to wetland health, as well as providing man with a natural mechanism which moderates the extremes of flooding and drought. Many wetland plants and animals depend on fluctuations in water level for their existence. For example, high spring waters stimulate the growth of sedges, but since they must be slightly above the water level for effective growth, they depend upon the gradual subsidence of spring flood waters. Likewise, the lowering of the water table provides nesting places for ducks and other water fowl. Erratic and unnatural patterns of water fluctuation, however, will seriously damage these species.

Man's influence on water hydrology generally exaggerates these fluctuations. This can be seen in Figure VI-2. Under natural conditions, upland runoff is slowed by vegetation. The percolation of this water into the ground reduces the amount of water entering the marsh and also stores water in the ground. Under agricultural or urban conditions this process changes. Greater amounts of precipitation are released to overland flow, covering wetlands with much higher water in the spring and in turn demanding more of its water for groundwater recharge in dry periods. If a community is pumping groundwater for its water supplies, then this fluctuation is exaggerated even more and marsh ecology is disturbed to a greater degree.

If we want to maintain and stabilize water supplies--to reduce the danger of floods in other areas of the watershed and to reduce the chances of drought in the immediate area of the wetland--then we must protect our

Figure VI-2



Urbanization and wetland water level fluctuation

wetlands. Particularly "temporary" wetlands, the low prairies, the sedge meadows, and the shallow marshes that are wet part of the year and dry at other times, must be preserved. These areas are often overlooked, but make important contributions to our water resources.[8]

3. Wetlands and General Environmental Health and Diversity

Wetlands provide essential breeding, nesting, resting, and feeding grounds and predator escape cover for many kinds of fish and wildlife. Since the food webs of land and water are most intimately connected in wetlands, they are thus important for supporting a wide variety of both land and water animals. Likewise, wetlands provide habitats for a wide range of vegetative communities which could not exist without them. In these ways wetlands provide the benefits of healthy environment. They are sites for recreation, research, and education; they support wildlife and game for hunting, fishing and trapping, and they add to the aesthetics of the community. Local government, in turn, is concerned about these benefits because they are intricately connected with its desire to promote the most suitable use of land, to prevent nuisance-like uses of land which harm common resources, and to protect residential quality and the economic base of the community.

To a large extent, if marshes are successful in performing their water quality and quantity functions, species diversity and environmental health will follow as a matter of course. However, it is important to understand why this third function is important and how it works.

Present ecological theory urges that the more varied an environment is in terms of habitat, flora, and fauna, the more stable it is. Stability in an ecosystem means the lack of large fluctuations due to inside or outside disturbances. It depends upon species diversity because the more channels there are for diverting and dispersing the results of disturbance, the less likely it is that there will be abrupt population changes.

This process can be appreciated by looking at its opposite--monoculture. The soybean farmer replaces hundreds of species by, he hopes, only one. The results are attacks of pests, outbreaks of weeds, and disease. Since the most important way in which the multitude of species in a natural community interact is through the food web, it is easy to see why there are pest outbreaks among the crops. With a large amount of one type of food available, the plant-eating pests, or herbivores, increase rapidly along with the increase of food supply. The farmer sprays pesticides on the pest population, but in the process kills or harms the predator birds and insects. Since the major natural control of herbivore populations is by predation, the pest population without its natural check will become even more uncontrollable once it breaks out again.

It is reasonable to assume that the existence of alternate prey and predator animals will help stabilize populations. The raccoon, for example, has the eggs of several different species of marsh birds to eat, as well as crayfish and numerous other foods. No one single prey population will take the brunt of the raccoon's foraging. From the raccoon's point of view, if one prey population fluctuates, he can still survive. The presence of several different predator species will also be important in controlling populations. A frog, for example, can be eaten by a heron, a bittern, or an osprey, among others. If one predator population is low, the others will keep the frogs from becoming too abundant. The same types of relationships exist throughout the marsh ecosystem. The muskrat, as a herbivore, keeps the cattail population stable so that it will not choke the marsh.

Within a healthy, diverse ecosystem, each plant or animal species will have its own functional position, or niche. A niche is the sum of the relationships a species has with the rest of the system: what it eats, how, and when; what temperature it prefers; whether it is active by day or night; what plants it uses for cover and nesting; and so on. The theory of the niche assumes that species avoid direct competition by not using the same resources in the same way at the same place and time. Niches may overlap partly, but not completely. Thus species complement each other, rather than being in constant, direct competition.

Wetland ecosystems are more complex in terms of this species diversity than some other systems. One explanation is that they have a number of edges or boundaries between structurally different vegetation. At such edges the greatest diversity generally occurs. Along their immediate uplands wetlands may be surrounded by trees or shrubs, then as the gradient declines there will be sedge meadows or shallow marshes, and finally a change to deep marshes and open water. Each of these areas provides niches for different plants and animals. Generally man simplifies these systems by creating conditions unfavorable to certain plants and animals. We can crowd a marsh so that predators such as the mink and fox do not have enough escape routes. Or excess nutrients and siltation give a competitive advantage to one species over another, resulting in an imbalance.

By understanding the function of a marsh in providing species diversity through its niches and edges, it is possible to style a regulatory program which will be compatible with it. When alterations are necessary along the edges of the marsh, it is possible to maintain a gradient that will preserve the diversity. By thinking of wetland systems as a number of marshes connected by streams or other modes of linear movement, man will have his homes and the foxes will still have their escape routes. By thinking in terms of the wetland's function of diversity, it is possible to implement a public policy goal which says: We want to protect wetlands because they provide the value of recreation, education, and general environmental health.[9]

4. Coastal Wetlands

Improving water quality, moderating floods and stabilizing water supplies, and providing overall environmental health and diversity are important functions of coastal wetlands, too. But because they are at the boundary of our land and sea resources, coastal wetlands have several unique characteristics and ways in which they serve the public interest. These are described in John Clark's Coastal Ecosystems as the following:

A. Coastal wetlands provide varied habitats for wildlife. Coastal wetlands are those vegetated partially or completely submerged areas which occur along the coastline, particularly along the wide continental shelf of the Atlantic and Gulf coasts. They may lie along the margins of bays, estuaries, or lagoons, those confined coastal water bodies with varying degrees of connection to the sea. They can be freshwater marshes along estuaries where rivers mix with the sea, or they can be saltwater marshes or tidal flats fed by incoming ocean tiedes. (See Chart p. 173 for a listing of coastal wetland types.) Like inland wetlands these coastal wetlands may be constantly submerged, or may be alternatively dry or wet depending on the seasonal flow of rivers or the fluctuations in tides.

These wetlands are not only edges between the land and sea, they are also edges between fresh and salt water. During spring floods from the rivers and streams, an adjacent coastal wetland may be predominately fresh, but in other seasons tidal flow may make its waters predominately saline. Since the life cycles of many shellfish, as well as sport and food fish, depend upon this gradual, variable mixing of fresh and salt waters in estuaries, bays, lagoons, and their associated wetlands, interference with freshwater flow into them can seriously alter the natural balance and damage our fishing industry. The striped bass, for example, requires freshwater coastal marshes for breeding, and the Gulf shrimp requires such areas for reaching maturity.

Channelizing coastal wetlands can alter the fresh groundwater flow into them, and interception of streams and creeks in dams or alteration of watercourses can also decrease the amount of fresh water available in an estuary or bay. Of course, if river water is purified and returned after use by a city or industry to continue its path to the sea, the availability of fresh water in coastal wetlands remains sufficient to provide the variety of habitats needed to sustain many coastal animals and plants.

B. Coastal wetlands are highly productive areas. The many varieties of plants in coastal wetlands trap nutrients and store them in their leaves and vegetative debris. These coastal wetland plants and the animals which feed on them are 20 times more productive than the deep sea and 10 times more productive than nearshore water areas. Though coastal marshes seem to have an overabundance of plants and animals, much of the energy stored in the plants and soil is accumulated and released slowly and is more like a bank than an overstocked larder.

In part because of this high rate of productivity, as well as the variety of fresh and salt water habitats, coastal wetlands are used by over 60-70% of the sport and game fish found in the Atlantic and Gulf of Mexico for feeding, breeding, maturing, and wintering. Many waterfowl are similarly dependent on coastal wetlands. Interfering with nutrient availability, either by decreasing it or increasing it and overtaxing the wetland's ability to trap and store nutrients, can damage these highly productive areas. In southwest Florida, for example, the Fahka Union Canal flushes water so rapidly through the bay's mangrove swamp that nutrients cannot be trapped and stored. Dumping of wastes and polluted water or even siltation can likewise destroy the health of coastal wetlands.

C. Coastal wetlands are barriers to storms and floods. Like inland wetlands, coastal marshes can absorb and retain significant amounts of flood water from rivers. They can also absorb storm water from the sea, as well as buffer inland areas from storm erosion. Thus their destruction can deprive a coastal community of a valuable safeguard against hurricanes and winter storms.

D. Because of their location along densely populated coastlines, coastal wetlands are especially vulnerable to disturbances. In addition to the common dangers of dredging and filling and too much siltation or nutrient input, coastal wetlands can be harmed by both an increase or decrease in freshwater flow. They are also highly susceptible to thermal pollution from power plant discharge, and many breeding fish and their young can be destroyed by water intake for power plants or municipal supplies. Since many coastal wetlands are partially confined in bays, estuaries, or lagoons, flushing their waters out to sea is a slow process. Thus, once they are polluted from waste discharge, dumping, or siltation, or agricultural runoff, they remain polluted and damaged for many years.[10]

C. An Evaluation of Local Wetland Regulation

To understand the evolution of police-power regulation over wetlands it is necesary to look at previous attempts towards their conservation. These early attempts were mainly concerned with acquisition.

1. Limitations of Acquisition Programs

In 1961 the federal government passed the Open Space Land Act. This Act provided matching funds from the federal government for open space acquisition. A number of local communities took advantage of the federal assistance to make purchases of important wetlands areas. From 1961 to 1963 the city of Madison, Wisconsin authorized expenditures of $1,600,000 for acquisition for conservation and park lands. Part of the funds was used to acquire 1,000 acres of the 4,000 acre Cherokee Marsh. Federal funds supplemented this money with $209,000. Similar acquisition programs also occurred on Long Island. Dedication of 10,500 acres of wetlands in 1965 by the Town of Hempstead and 5,000 acres by Oyster Bay in 1967 now accounts for 15,500 acres in Nassau County under protective local-state management via the Long Island Wetland Act.

Acquisition programs, however, have severe limitations. The first of these is cost. Wetlands do not bring high prices themselves, but when purchasing wetlands, local communities find themselves paying for the development value of the land. In 1968, the appraised values of Long Island wetlands ranged from $3,500 per acre in the Hamptons to as high as $20,000 per acre in Nassau County. At that time the purchase price for all the remaining tidal marshes alone was calculated to be a minimum of $94,000,000. Consequently, when considering the size of the nations wetlands, it is clear that acquisition is only feasible for a very small percentage of the whole.

The second limitation of acquisition is that it is too slow. Acquisition programs are generally scheduled over several budgetary periods. With each passing period, the value of the land increases and the cost of acquisition increases. Further, as the time frame is extended, wetland resources are lost to continuing development. This leads to a situation where the size of the available resource is shrinking coupled with increased unit prices. In this situation, local communities often stop the acquisition program rather than spend more dollars for less wetland.

The third limitation of acquisition concerns the scale of purchase. In almost all cases, acquisition is limited to the specific site of the resource. Unfortunately, the preservation of the wetland acquisition can be meaningless if not accompanied by watershed-wide measures of protection. In this instance, the local community could well end up with a wetland resource in a totally degraded state. Acquisition cannot account for the larger watershed.

A good example of the failure of acquisition is with the previously mentioned Cherokee Marsh in Madison, Wisconsin. Since the advent of the acquisition program, the marsh itself has dwindled from 4,000 acres down to 2,000 acres. The marsh sits in the path of suburban development. With each passing budgetary period, the once operative marsh is becoming less and less ecologically stable. There is the serious danger that the city will lose its entire investment due to pollution and siltation from surrounding development. Consequently, the acquisition program may easily result in public ownership over a limited area which is no longer a functionin marsh. In a report currently being conducted for the relevant planning agency, these concerns are outlined in depth. Since it is clear that acquisition is not sufficient, the report will suggest a move to police power regulation.

The failings of acquisition suggest a positive role for wetlands regulation. In contrast to acquisition, regulations are relatively inexpensive, they are timely, and they can account for the influence of the larger watershed.

2. Wetland Conservancy Districts

The most striking development in the local regulation of wetlands has been the wetland ordinances or wetland conservancy districts. While not all of these acts are in the zoning ordinances, they function either as special districts or overlay districts that are designed to encompass most, if not all, of a community's wetlands. They all follow a basic pattern and attempt to implement many of the public policy considerations outlined in the previous section. One can obtain a feel for their comprehensiveness of concern in the statement of purpose for the New Castle, New York Wetland Ordinance:

> Rapid population growth attended by housing, roads and other construction and increasing demands upon natural resources is found to be encroaching upon, despoiling, polluting, or eliminating many of the Town's wetlands, water bodies, water courses, and other natural resources and processes associated therewith.
>
> The preservation and maintenance of wetlands, water bodies and water courses in any undisturbed and natural condition constitutes important physical, ecological, social, aesthetic recreational and economic assets necessary to promote the health, safety and general welfare of present and future residents of the Town and of downstream drainage areas.
>
> It is the intent of this Law to promote the public purpose identified in this Section by providing for the protection, preservation, proper maintenance and use of the Town's wetlands, water bodies and water courses by preventing or minimizing erosion due to flooding and storm water runoff, maintaining the natural groundwater supplies, preserving and protecting the purity, utility, water retention capability, ecological functions, recreational usefulness and natural beauty of all wetlands, water bodies, water courses, and other related natural features of the terrain, and by providing, protecting and appropriating for natural wildlife.

These statements vary somewhat in their focus. The Orono, Minnesota Wetland Ordinance, for example, has less focus on strict preservation and adds a list of specific intents which stress the importance of wetlands to the community in terms of (1) reducing future costs from pollution of adjacent waters or; (2) from the possible necessity of installing flood control devices or; (3) from running into difficulty with groundwater supplies. Like the New Castle ordinance, however, all of them are responding to the major concerns about wetlands: they seek to maintain them as an ecological system which functions to purify water, to maintain groundwater stability, and to provide species diversity.

In order to maintain these functions, the regulations generally follow the prescription of: (1) Use lists limited to nonintensive uses so as to minimize the impact of development on the wetland; (2) Restrictions on dredge and fill so as to maintain identity of the marsh.

Dredge and fill restrictions vary in their intensity. In some cases, the activity is entirely prohibited. For example, in the Orono, Minnesota ordinance:

> No filling, grading, dredging, excavation or construction shall be allowed within the Flood Plain and Wetlands Conservation Area; nor on lands abutting, adjoining or affecting said area if such activity upon those adjacent areas is incompatible with the policies expressed in this ordinance and the preservation of those wetlands in their natural state.

Generally, however, the wetlands ordinances keep a permit procedure typical of general excavation ordinances. As in the Little Silver, New Jersey ordinance the prohibitions are the same as the Orono ordinance except that it is unlawful "without obtaining a written permit." The permit procedures require detailed information on the purpose of the removal or disposition operations, the exact nature of the activity, and the manner in which it will be done. Then, through a process of hearings and reviews by the Borough Council, the Borough Engineer, the Planning Board, and the Conservation Commission, a decision is made.

The wetlands ordinances are less specific about other construction activity. In contrast to the Orono statement, few make reference to activities on adjoining lands which may seriously damage the regulated area. Most include activities only within the wetland itself.

This lack is one of the chief weaknesses of the wetlands ordinance. By their nature, they are strictly focused on the wetland themselves. The boundary definition in the Coon Rapids Conservancy District illustrates this point:

> District boundaries in a wetland area are intended to represent the edge of a swamp, marsh or other wetland area. The edge shall be defined as the mark delineating the highest water level which has been maintained for a sufficient period of time to leave evidence upon the landscape. The edge is commonly that point where the natural vegetation changes from predominantly aquatic to predominately terrestrial.

Other ordinances, such as that recommended in the Virginia Wetland Act, identify the areas by specific plant types to avoid the confusion of what is predominantly aquatic and what is not, but in such cases the regulated area only includes the wetlands themselves without any buffer protection.

3. Mapping Wetland Districts

The boundary of wetland and fringe districts present a second problem for the wetland ordinances. As shown in the previous section, the exact boundaries of wetlands are difficult to establish. They fluctuate from year to year depending on seasonal rainfall, and their boundaries change as the wetlands adjust to either natural or manmade disturbances. They can either expand or contract from these disturbances. The USGS is presently doing research on large scale and satellite mapping of wetlands--specifically coastal wetlands--but at the present moment the best methods are still low altitude aerial photography with some field research. This method, however, can involve considerable expense. Such an inventory may be a worthwhile expenditure since it would allow a community to evaluate their wetlands in terms of their quality and specific threats to their health. Dane County, Wisconsin, and New Orleans, Louisiana, have gone to such expense and have gained considerable information from it.

In lieu of this procedure, communities have taken one of two tactics. They have either placed the wetland ordinance outside the usual zoning ordinance and left it unmapped, or they have set up tentative mapping procedures with mechanisms for adjusting them for inaccuracies. The Open Space Institute's model ordinance takes the first method. In this case, the community relies on the definition section of the ordinance to establish what is controlled and what is not. The model ordinance develops both a scientific description and a legal definition of marshes based on water-table or flooding and definitive plant species. However, most communities (such as North Castle, New York), however, rely on more vague definitions:

> Wetlands: Those geographical areas covered with shallow and sometimes temporary or intermittent waters (commonly referred to as marshes, swamps, and bogs).

There may be serious administrative problems with these more general definitions.

Because of the difficulty and ambiguity in the definition of wetlands, most communities have adopted mapping procedures instead. In this case, the wetland ordinance has been placed in their zoning ordinances as a mapped district. As an interim measure, until they have the time and money for a more extensive field inventory, Orono, Minnesota has used the USGS maps:

> Those areas designated and shown as marsh, wooded marsh, submerged marsh, inundation area, intermittent lake or intermittent streams by the United States Department of the Interior, through the Geological Survey on maps and supporting data designated as Mound Quadrangle, Minnesota (NW/4 Lake Minnetonka, (1958). Those maps are hereby made a part of this ordinance.

The maps are reviewed by field investigation on a case by case basis when the boundaries are questioned by a landowner. Farmington, Connecticut, has a similar procedure using the National Cooperative Soils Survey: "To prove himself exempt from these regulations the applicant must present documentation by a soil scientist that the land in question, or a portion of it, does not have a soil type classified by the National Cooperative Soils Survey as poorly drained, very poorly drained, alluvial, or floodplain." This mapping procedure was recommended by the Connecticut Inland Wetlands Project.

4. Defining Use Lists for Wetlands

Besides the problem of defining wetlands and the associated problems of the scale of regulation, the wetlands ordinances have other internal problems that are as yet unresolved. The most serious is designing the permitted acts which allow a landholder to obtain just return on his investment. The model wetlands ordinance design for the Open Space Institute lists the typical permitted acts:

a) Conservation of soil, vegetation, water, fish, shellfish and wildlife.

b) Outdoor recreation including play and sporting areas, field trials, nature study, hiking, horseback riding, swimming, skin diving, camping, boating, waterskiing, trapping, hunting, fishing and shellfishing where otherwise legally permitted.

c) Operation of dams and other water control devices including temporary alteration of diversion of water levels or circulation for emergency, maintenance or aquaculture purposes.

d) Grazing, farming, nurseries, gardening and harvesting of crops.

e) Boat anchorage or mooring.

f) Uses accessory to residential or other permitted primary uses of adjoining lands or waters provided they are consistent with the intent and objectives of this law.

Other ordinances do include some additional uses. The Lincoln, Massachusetts, Wetland District also permits "dams, excavations, or changes in water courses to create ponds for swimming, fishing, or other recreational or other agricultural use, scenic features or for drainage improvements." Presumably this use would allow for more commercial recreational development in the district which in turn would give greater return on the land.

The difficulty with this list is that those which are designed for allowing return on the land, such as farming or artificial impoundment of waters, could also cause severe damage to wetland functions. It is easy to imagine that a house resting on stilts above the wetland edge will have less effect on the wetlands than a herd of cows or a sod farm. Because peat oxidizes at a slow rate, any agricultural production will have to reply on the heavy use of fertilizers, and grazing will trample and destroy the vegetation during periods of low water so that the marsh ecology will be seriously disturbed. Consequently, these traditional light uses of grazinng and agriculture may be more damaging than some of the land uses that are usually associated with higher intensity use.

Such conflicts are hard to resolve. With the present style of land-use regulation it is impossible to allow residential or other developments as permitted uses in these areas because traditional construction techniques make them incompatible. On the other hand it is unclear if the courts will permit the severe restrictions that it is necessary to impose. As Fred Bosselman, et al. outline in their book, The Taking Issue, the court position of the regulation for the protection of wetlands and estaurine areas is changing.[11] In 1963, the New Jersey Supreme Court rejected an ordinance which created a Meadows Development Zone.[12] The regulation allowed a variety of agricultural uses, limited residential use in conjunction with the agricultural uses, outdoor recreation uses, public utility transmission and sewage and water facilities. It also allowed other uses through a special permit system. The Massachusetts Supreme Judicial Court reached a similar conclusion in MacGibbon v. Board of Appeals of Duxbury:

> The preservation of privately owned land in its natural, unspoiled state for the enjoyment and benefit of the public by preventing the owner from using it for any practical purpose is not within the scope and limits of any power or authority delegated to municipalities under the Zoning Enabling Act.[13]

The Massachusetts court, however, diminished this decision a year later in Golden v. Board of Selectmen of Falmouth. The Court found that "protecting the town's natural resources along its coastal areas" through a permit system was a legitimate exercise of local zoning powers. Only when permit denial was "based on a legally untenable ground, or [was] unreasonable, whimsical, capricious or arbitrary," would there be grounds for Court intervention.[14]

The change in the trend in judicial handling of these wetland cases had continued with the appellate court of California sustaining an order of the San Francisco Bay Conservation and Development Commission prohibiting filling of the Bay, and with the Wisconsin Supreme Court decision in Just v. Marinette County.[15] This latter decision gave approval to shoreline regulation, including wetlands protection which was beyond the "single objective" regulations of flood hazards. Jon Kusler, points out, however, in his article on open space zoning, that the courts have traditionally given great weight to regulations designed to protect public safety or prevent nuisances, while aesthetic, wildlife, and recreation values have been given less weight.[16] The courts also look unfavorably on zoning regulations which essentially provide only uses of public benefit and do not give the options of economic gains from private use.

There is no doubt that the wetlands ordinances are highly restrictive and may be challenged on that ground. The one private economic use--farming and grazing--may not be enough to satisfy a court that there has not been a taking without just compensation. At present, however, it looks like the communities need additional support for their actions. They cannot rely on the simple aesthetics of wanting to keep the marshes beautiful; they need to base their regulation on those functional qualities of marshes which relate to public safety and the prevention of nuisance-like uses of the land.

Most of the communities with wetlands ordinances have not run into legal difficulty. In part this may be simply due to their recent origins, but it is probably also due to the fact that the communities are forestalling court fights by building in as much flexibility as possible. Also, there has been little challenge to such ordinances since protective boundaries are generally the waters edge of wetlands, there is not much economic use without dredging and filling--essentially removing the wetlands. Likewise because many wetlands tend to be small areas strung out along stream courses or glacial morraines, the restrictions have not prevented landowners from using their uplands and have not caused substantial loss of them. Except in extraordinary cases, an individual would not invest in marsh land and nothing else, and if he knows there are restrictions on draining and filling it becomes even less likely.

D. Developing and Strengthening Local Wetland Programs

While wetlands regulations surmount many of the difficulties associated with the sole reliance upon acquisition, there have been serious internal problems. The most important of these are: (1) The problem of the restrictive use list; (2) The problem of controlling developmental activity in areas adjacent to wetlands; and (3) The problem of controlling key natural processes in the attendant watershed. The resolution of these issues would go a long way in maintaining the quality of the wetland resource.

1. Maintaining Use-List Flexibility

Since a highly restrictive use list strikes at the legal force of the regulation, it is important to instill some flexibility. Further, since some of the traditional "light" uses are clearly detrimental to the wetland resource, it is also advisable on environmental grounds.

The key property of a more flexible use list would be its emphasis on the performance of the use vis-a-vis the wetland resource. So long as the development proponent can show that the use will be compatible with the functions of the wetland, the use would be permitted. An example of this performance oriented approach is taken from the Coon Rapids, Minnesota, Wetlands Conservancy District. In this district, a special use category allows for development when it is "compatible and harmonious with the natural amenities of the Conservancy District":

> (d) Special Uses. If through good site and engineering designs a development can be created which is compatible and harmonious with the natural amenities of the (CD) Conservancy District area and with surrounding land uses, then a request for a Special-Use Permit for such development may be submitted. Such requests shall be accompanied by an overall plan of the entire site showing roads, parking areas, lot lines, easements, the location of tree cover, including the designation of individual trees of 15" in diameter or more, the location of other natural and biological features such as wetlands and areas of valuable wildlife habitat, the location of proposed structures, existing contours and proposed grading, drainage, utilities, and landscaping in such details as the City Planner and City Engineer shall require before it may be reviewed by the Planning Commission. The approval of such request by the City Council shall require a finding that:
>
> (i) The development will not detrimentally affect or destroy natural features such as ponds, streams, wetlands, and forested areas, but will preserve and incorporate such features into the development's site design.
>
> (ii) The location of natural features and the site's topography have been considered in the designing and siting of all physical improvements.
>
> (iii) Adequate assurances have been received so that the clearing of the site of top soil, trees, and other natural features before the commencement of building operations will occur. Only those areas approved for the placement of physical improvements may be cleared.
>
> (iv) The development will not substantially reduce the natural retention storage capacity of any watercourse, thereby increasing the magnitude and volume of flood at other locations.

(v) The soil and subsoil conditions are suitable for excavation and site preparation and the drainage is designed to prevent erosion and environmentally deleterious surface runoff.

(vi) The development will be free from offensive noise, vibration, smoke, dust, and other particulate matter, odorous matter, fumes, water pollution, and other objectionable influences.

(vii) The petitioner will be substantially damaged by being required to place the intended development outside the CD District.

This special-use statement recognizes that there may be developments which fit with the natural environment and should not be excluded. It emphasizes the reasonableness of the community to consider alternatives to the use categories they have specified and sets out some general guidelines for accepting or rejecting the proposal. This clearly provides the landowner a means of potentially using his land.

Density transfers are another technique for providing flexibility in land-use restrictions. These allow landowners to shift their development rights from one part of their land to another. Density transfers are similar to development rights transfers except that they are not sold on an open market. They work by a formula which relates developable land to wetlands. The Orono ordinance allows the developer to count an equal portion of the wetlands as he has developable land:

> When land to be developed is connected to a public sanitary sewer line and includes land within the Flood Plain and Wetland Conservation Area, the owner or developer thereof will be credited with an amount of his land within the Flood Plain and Wetlands Conservation Area equal to but not exceeding the amount of his adjacent land which otherwise qualifies for development under these ordinances for purposes of complying with the land-use density, open space, building-unit-to-land-area ratios,or other similar requirements of the land development and zoning ordinances of the Village except for requirements for recreational uses.

Palatine, Illinois, also uses this technique in their floodplain ordinance. They have developed a sliding-scale formula: the greater the percentage of total property in the flood plain, the less the percentage of that area which can be used to calculate density and floor area transferable to the remainder of the tract. They have also included a provision which allows contiguous land owners with less than five acres to assemble property with adjacent owners to develop a unified plan. They hope this will lead to more integrated land planning in these areas:

> 5. Density Transfer. The Flood Plain Areas in calculating the floor area or lot-size density for an entire tract of land (hereinafter referred to as "density transfer") in accordance with the following conditions and restrictions:
>
> (a) Density transfers shall not be permitted for tracts of land less than five (5) acres in size; provided that owners of two or more tracts of contiguous land may agree to have such tracts considered as a single unit in order to qualify for density transfers hereunder.
>
> (b) A plat of survey shall be submitted with each application for density transfer, together with a certification by a registered professional engineer in the State of Illinois, certifying as to that portion of flood plain which covers the subject tract or tracts of land. Precise location of the flood plain shall be shown on a topographic map at a contour interval of not greater than two (2) feet.
>
> (c) The maximum allowable density which may be transferred shall be computed in accordance with the following table:

Percentage of Total Tract in Flood Plain	Portion of Tract in Flood Plain Which May be Used in Calculating Density for the Entire Tract
Less than 25%	100%
25% to 50%	75%
50% to 75%	50%
75% or more	25%

(d) The President and Board of Trustees may prescribe such other reasonable limitations, conditions and restrictions upon transfer of density in each case as are in the interests of preserving the public safety, health, comfort, and welfare.

Similar techniques are employed by allowing the wetlands to count as yard requirements or open space requirements in either residential zones or planned unit developments.

The courts have frowned on highly restrictive districts which continue to tax and assess the land on the basis of developed use. The communities cannot restrict all uses and still continue to levy taxes or assessment which assume that a land will be developed. Most communities have attempted to adjust for this consideration by developing special tax and assessment policies. It is difficult to do this with the property tax since it goes against the uniformity requirements of constitutional provisions in many states. Presumably the value of the land will decline because of the local government's restrictive regulation. The uncertainty of whether a purchaser will be able to use the land through a special-use permit or through variance procedures or zoning changes should depress the value of the land. Logically this will lower the property tax assessment against the land, but unfortunately these assessments are a reflection market value, and the market does not follow local zoning considerations.

One way, however, of giving special tax consideration to these lands is through some process of easements or dedications which do not necessarily require public access. If the landowner provides the community with a permanent scenic or conservation easement to run with the land, then the valuation of the land can be adjusted for the purposes of real estate taxation. In addition the landowner can use the value of the easement for an income tax deduction as a contribution or gift.

Some communities have put such provisions into their wetland ordinances. This has the advantage of publicizing this possibility to landowners, and it also places responsibility on the community for accepting any of these easements and adjusting property taxation accordingly.

A more general technique for providing a landowner a financial consideration for his land is to remove his obligations of special assessments to defray the cost of municipal improvement projects such as sanitary sewers, water mains and storm sewers. These assessments represent a much smaller amount of revenue than the property tax, but it does provide a break for the landowner. Since the special assessments are not a tax, the community has much discretion in administering them. The only requirement is that they cannot charge more than the special benefits derived, but they can defer or adjust to them. Consequently, most communities do not count the area within the wetland protection district when calculating these assessments.

There is some advantage in deferring rather than zero assessment for these areas since it would deflate the value of the land for development. This would operate as a check on a landowner taking advantage of a special assessment break and then trying to develop the land later when the value has increased. Another check on this abuse is to require an easement in the same manner as that for property tax devaluation. If the easement route is taken, then these conditions are included in the wetlands ordinance.

2. Buffers to Control Development Activity Adjacent to the Wetlands District

Obviously, it makes little environmental sense to place strict controls over the wetlands and ignore activities occurring at the boundaries of the wetland district. Hence, the buffer concept is a useful device whose essential purpose is to maintain compatible development adjacent to the wetlands district.

Areas adjoining wetlands districts tend to exhibit continued sensitivity. Sensitive soils, watercourses, steep slope areas, recharge areas are often found in close proximity to wetland areas. Further, even if the adjacent land is not sensitive in itself, the proximity to the wetland calls for special attention. The buffer zone can provide this attention.

A wetland buffer zone can follow two basic approaches. First, the buffer can be a fixed area from the boundaries of the wetland district. This might range from 50 feet to 200 feet depending on the importance of the wetland area. Second, the buffer might take a minimum fixed area, coupled with the flexibility to incorporate sensitive land areas beyond the fixed area. The Central New York Regional Planning Commission has recommended that the wetlands regulation include a 1,000-foot buffer with a limitation of five per cent impervious surface within this area. In Washington, the Shoreline Management Act established a buffer zone running 200 feet in all directions from the mean high water line to all wetlands above a minimum size. Within this fixed area, the objective is to establish stringent environmental controls over a larger list of permitted or special uses. Key among the controls would be protection against the by-products of increased use, as liquid wastes, runoff, erosion, and sedimentation. The control could be exercised through limitations on impervious surface, through extensive performance requirements for control of erosion and runoff, or in the case of liquid waste,through stringent regulation of private sewer systems. If commercial and industrial uses were allowed in this zone, it would also be necessary to give careful attention to the possibility of waste disposal resulting from internal commercial processes. In most cases, the objective should be to limit commercial and industrial uses to those with no significant liquid waste products.

The floating buffer would be directed toward essentially the same purposes. The use list might be expanded, but more stringent controls would be placed on the by-products of the various uses. With the floating buffer, the local community might establish a minimum buffer, coupled with the potential to expand depending upon the presence of related sensitive land areas. The dimensions of the buffer could easily be taken from maps indicating soil type, slope, drainage patterns, etc. The buffer boundary would vary with the presence or absence of adjacent sensitive land areas. For any specific development within this area, the proponent would be required to show the relation between the proposed use and related sensitive land areas. In this way, the buffer could float and account for the sensitivity of land.

The principal disadvantage of the floating buffer is simply the availability of the requisite information. In those areas with a paucity of environmental information, the fixed buffer would be more attractive. In those areas with extensive topographical information, the floating buffer would make more sense. In both cases, the objective of the buffer is to allow for an expanded range of uses while placing strict controls over the by-products of these uses. The use of the buffer zone complements the basic wetlands control in serving to minimize negative developmental consequences in lands adjoining the wetland area.

3. Controlling the Attendant Watershed

The final difficulty with the sole reliance upon wetlands districts for preserving the wetlands is simply that the wetland is, in large measure, a reflection of the larger watershed. What happens in the watershed will eventually happen in the wetland. Consequently, the effectiveness of wetlands regulations is closely tied to the effective control of development in the watershed.

In the watershed, two key natural processes are directly related to health of the wetland. These are the processes of runoff and erosion. Under natural watershed conditions, the wetland is generally able to control and maintain its important functions. However, as the watershed becomes progressively more developed, the capacity of the wetland to deal with erosion and runoff is overwhelmed. To maintain the wetland, the processes of runoff and erosion must be controlled throughout the watershed. With no control, presence or absence of wetland districts would make little difference. This control is a precondition to wetland regulation.

A more complete discussion of the necessity for and the methods of control over these natural processes is contained in Sections IV of this report. The design of wetland regulations should only occur in the context of these larger controls. If these watershed controls exist, then the wetland district receives critical environmental support. If not, the long-term effectiveness of wetlands regulation would be in serious question.

Wetland regulation surmounts many of the difficulties associated with sole reliance upon acquisition. The regulations cover broader areas, may be quickly designed and implemented, and allow for wider public participation.

However, in order to preserve the important functions of the wetland they should be complemented by the use of buffer zones for adjacent areas and by watershed-wide controls over runoff and erosion. In facing the problem of restricted use lists, wetland and buffer zone regulations should allow for special uses. The basic principle in the evaluation of the special uses would simply be that the uses would be compatible with the maintenance of the important functions of the wetland. Local communities might also consider the use of density transfers or perhaps transferable development rights to preserve these functions while, allowing for additional uses in less sensitive areas.

In accounting for the negative influence of development at the wetland site, in adjacent land areas, and throughout the attendant watershed, local communities will move closer to the real goal of wetland regulation. The goal is to preserve the important functions of the wetland, such as moderating water flow, filtering water for adjacent lakes and rivers, and providing species diversity for an area. In this more inclusive regulatory framework the goal is more likely to be achieved.

FOOTNOTES

1. Samuel P. Shaw and C. Gordon Fredine, *Wetlands of the United States. Their Extent and Their Value to Waterfowl and Other Wildlife* (Washington, D.C : U.S. Government Printing Office, 1956), pp. 5-9.

2. Peter L. Johnson, *Wetlands Preservation* (New York: Open Space Institute, 1969), pp. 9-12.

3. "Need Land? Then Take a Look at Marshland," *House and Home* (April 1958), pp. 146-52.

4. Johnson, pp. 9-12.

5. The EPA policy on wetlands is outlined in the *Federal Register*, Wednesday, May 2, 1973, p. 10834.

6. John Clark, *Coastal Ecosystems. Ecological Considerations for the Coastal Zone* (Washington, D.C : Conservation Foundation, 1974).

7. For figure sources and a more detailed discussion of eutrophication and wetlands as sediment and nutrient traps see the following: Barbara Bedford, Elizabeth H. Zimmerman and James H. Zimmerman, *Wetlands of Dane County, Wisconsin* (Madison, Wis : Dane County Regional Planning Agency, 1975, pp. II-10 to II-17. (Page citation to early draft.)

8. For an in-depth study of wetland hydrology and management, see:
   Harriet A. Irwin, A Natural History Study of East Marsh of the University of Wisconsin Arboretum, M.S. Thesis (Madison, Wis : Department of Botany, University of Wisconsin, 1973).

9. For further reading on the concepts of ecological diversity and succession see the following sources:
   Bedford, pp. II-18 to II-35;
   Robert L. Smith, *Ecology and Field Biology* (New York: Harper and Row, 1966), Chapter 6;
   Eugene P. Odum, *Fundamentals of Ecology* (Philadelphia: W.B. Saunders, 1971), p. 148.

10. Many of the concepts included here are discussed in terms of freshwater, inland wetlands. However, much of what has been said is applicable to coastal, saline wetlands. For further reading on coastal wetlands specifically, see the following sources:
    Clark, *op. cit.*;
    John and Mildred Teal, *The Life and Death of a Salt Marsh* (Boston: Atlantic Monthly Press, 1969).

11. Fred Bosselman, David Callies, and John Banta, The Taking Issue (Washington, D.C.: U.S. Government Printing Office, 1973), p. 214.

12. 40 N.J. 539, 193 A.2d 232 (1963).

13. 356 Mass. 696, 255 N.E.2d 347 (1964).

14. 265 N.E.2d 573 (Mass. 1970)

15. 56 Wis.2d 7, 201 N.W.2d 761 (1972)

16. Jon A. Kusler, "Open Space Zoning: Valid Regulation or Invalid Taking," Minnesota Law Review (Nov. 1972), p. 21.

BIBLIOGRAPHY

Bedford, Barbara L., Elizabeth H. Zimmerman and James H. Zimmerman. Dane County, Wisconsin. Madison, Wisconsin, Dance County Regional Plg. Agency, 1975.

This report of a study for the Dane County Regional Planning Commission is an example of an excellent wetland inventory including an analysis of special values of individual wetland areas. Special attention has been given to finding compatible uses for wetland areas of the county and recommending management techniques to preserve these values.

Clark, John. Coastal Ecosystems. Ecological Considerations for the Coastal Zone. Washington, D.C., The Conservation Foundation. 1974. 178 pp.

A guidebook that has compiled a large amount of ecological data on coastal ecosystems and applied the relevant information to make an excellent statement on protection of coastal resources. Contents include: Ecologic Considerations, Environmental Disturbance, Resource Evaluation and Protection (lists 15 types of coastal areas in this discussion), and finally a chapter on constraints and specific uses for coastal areas, from airports to mosquito control. An excellent, comprehensive study of the coastal zone management issue.

The Connecticut Arboretum. Preserving Our Freshwater Wetlands. Bulletin No. 17. (New London, Connecticut: Connecticut College, June 1970). 51 pp.

Documents the value of freshwater wetlands and describes preservation methods. Especially useful is an article on "The Ecology of Wetlands in Urban Areas," and a reprint of the now out-of-print Open Space Institute Wetlands Ordinance.

Lavine, David. Implementation Aids for Inland Wetland and Watercourse Agencies. (Middletown, Connecticut: Connecticut Inland Wetlands Project. 1973). 24 pp.

A guide to agencies administering the state's Inland Wetlands Act. Offers assistance in inventorying wetlands and watercourses, rates the compatibility of various activities with wetlands, and gives a checklist for administering application procedures. Some bibliographic material.

Smith, Robert L. Ecology and Field Biology. New York. 1966.

An excellent basic ecology textbook with chapters on wetlands and woodlands. Chapter 9, Bogs, Swamps, and Marshes, and Chapter 11 on Estuaries, Tidal Marshes, and Swamps describe the ecosystems of freshwater and coastal wetlands. Not overly technical.

A SELECTED LIST OF COMMUNITIES WITH WETLANDS REGULATIONS

Coon Rapids, Minnesota
Planning Department
1313 Coon Rapids Boulevard
Coon Rapids, Minnesota 55433

Dartmouth, Massachusetts
Planning Board
Town Office Building
South Dartmouth, Massachusetts 02748

Easthampton, New York
Planning Department
Town Hall
Easthampton, New York 11937

Farmington, Connecticut
Planning Department
Town Hall
Farmington, Connecticut 06032

Hempstead, New York
Planning Department
Town Hall
Hempstead, New York 11551

Lincoln, Massachusetts
Planning Department
Town Hall
Lincoln, Massachusetts 01773

Little Silver, New Jersey
Planning Department
Town Hall
Little Silver, New Jersey 07739

Nashua, New Hampshire
Nashua Regional Planning Commission
115 Main Street
Nashua, New Hampshire 03060

Town of New Castle, New York
Town Clerk
Town Hall
Chappaqua, New York 10514

Town of North Castle, New York
Town Clerk
Town Hall
Armonk, New York 10504

Orono, Minnesota
Planning Department
P.O. Box 66
Crystal Bay, Minnesota 55323

Richmond, California
City Planning Department
City Hall, Civic Center
Richmond, California 94804

Smithtown, New York
Town Planning Board
P.O. Box 757
Town Hall
Smithtown, New York 11787

DATA NEEDS AND TECHNICAL ASSISTANCE

Since wetlands types range from wet prairie to deep cattail marsh and are characterized by different vegetation and water levels, identification of wetland areas is somewhat difficult. The cyclical and fluctuating nature of wetland water levels adds another element of confusion to mapping them. If you need basic information on where your community's wetlands are located or whether or not any exist in your area, the State Geological Survey has topographic quadrangle maps that indicate the locations of wetlands. The maps are available for almost all areas of the country in a 15-1/2 degree scale and for some areas at 7-1/2 degree scale (get the 7-1/2 degree scale if they have it; they are more detailed), and are available at many public and university libraries, selected bookstores and from the USGS Distribution Branches in Arlington, Virginia; Denver, Colorado; and for Alaska in Fairbanks. There is an index map for each state that indicates which topographic map will cover your local area.

Since peat soil occurs in wetlands, the SCS soil maps are also helpful in identifying the location of wetlands through soil types. Few libraries carry these, so go directly to your local SCS office if you know where it is. If not call the State Conservationist to find out (See Appendix E, page 512).

Now you know where the wetlands are. The next step is to identify the type of wetland and evaluate its relative state of health. This requires a plant and animal inventory and an estimate of the degree of sedimentation that has occurred. You'll need somebody who is a field ecologist, field botanist, game biologist or any naturalist type who has a knowledge of wetland vegetation and wildlife. The SCS and Cooperative Extension Service, who work very closely together in some areas, have people who fit these descriptions. Within the SCS you should go directly to the state conservationist, (see Appendix E, page 512), who has access to professionals--including soil scientists, biologists, hydrologists, economists, foresters, and other people that are involved in natural resource conservation. The state conservationist can refer you to a district or local office of the SCS and consequently to people who have a more specific knowledge of the land area in question.

Since the Cooperative Extension Service is also a part of the USDA, some of their personnel may overlap with the SCS. The CES operates out of the land grant universities and colleges that exist in every state. As part of the CES there is a county agent in almost every county seat in the nation who could be contacted through the regular county offices. The agent can draw upon the resources of the cooperative university for expertise in a vast number of professional fields. If you would rather find the professionals yourself, the Agriculture Department handbook number 305, available at libraries and through the SCS in Washington, D.C. is a directory by state and area of expertise of all of the people working for the Extension Service.

There are a number of private organizations that maintain an interest in preserving wetlands, some of which have scientists and professionals that could offer assistance in evaluating wetlands and other natural area. The

National Wildlife Federation and National Audubon Society have local chapters throughout the country whose memberships include these people and other amateur naturalists who have an interest in conservation and may be willing to volunteer some time to take a look at your wetland.

With regard to wildlife use of a wetland, the U.S. Fish and Wildlife Service, formerly the Bureau of Sport Fisheries and Wildlife, and state and local game biologists can tell you what kinds of waterfowl, game fish, and endangered species use a given wetland. You can find out who that is by calling the closest regional office of the USFWS and asking for the Associate Director for Federal Assistance, who will refer you to the state wildlife commission or state game biologist. (See Appendix C, page 510).

By now you should have some idea of the environmental value of your wetland, its variety, health, wildlife value and so on. Finally you need data on the relationship of the wetland to both surface and ground waters. How will well pumping affect the wetland? If it is drained will there be increased flooding? The USGS and State Geological Survey are equipped to answer these and other questions that pertain to hydrology.

APPENDIX VI-a

VILLAGE OF ORONO

ORDINANCE NO. 125

AN ORDINANCE RELATING TO MARSHES, WETLANDS AND LANDS ABUTTING MEANDERED LAKES AND WATERCOURSES: PROHIBITING DEVELOPMENT OF THOSE LANDS AND PROVIDING FOR THE ISSUANCE OF PERMITS BY AMENDING CHAPTER 31 OF THE MUNICIPAL CODE OF ORONO BY ADDING SECTIONS THERETO.

THE VILLAGE COUNCIL OF THE VILLAGE OF ORONO ORDAINS AS FOLLOWS:

Section 1. Chapter 31 of the Municipal Code of the Village of Orono is amended as follows:

"31.800. Statement of Policy. It is in the public interest to protect against uncoordinated and unplanned land development which affect marshes, swamps, wetlands, drainage ways, lakes and watercourses within the Village of Orono, which development, if allowed to continue, will result in loss and damage to public and private improvements through inundation by flood waters and subsequent expensive construction of storm sewers and other public projects, in the permanent destruction of these natural resources, loss of water retention facilities, open space and wildlife habitats, and impairment of public and private water supplies. The objectives of this ordinance are to permit and encourage a coordinated land and water management program and the retention of open land uses which will locate permanent structures and artificial obstructions so as not to obstruct the passage of waters nor destroy the natural public water areas, marshes and wetlands within the Village. The Village Council has in mind its statutory obligation to adopt flood plain ordinance pursuant to Minnesota Statutes 1969, Chapter 104, the proposed regulations of the Minnetonka Conservation District, the open space policies of the Metropolitan Council and its guidelines encouraging protection of marshes, wetlands and the flood plain area, and the public interest in preventing irreparable destruction of valuable natural resources as expressed by numerous persons and organizations.

In addition to these general purposes, the specific intent of this ordinance is to:

(a) Reduce danger to health by protecting surface and ground water supplies from the impairment which results from incompatible land uses by providing safe and sanitary drainage.

(b) Reduce the financial burdens imposed both on the community and on communities within the Minnehaha Creek Watershed District and the individuals therein by frequent floods and overflow of water on lands.

(c) Permit and encourage planned development land uses which will not impede the flow of flood water or cause dange to life or property.

(d) Permit and encourage land uses compatible with the preservation of the natural vegetation and marshes which are a principal factor in the maintenance of constant rates of water flow through the year and which sustain many species of wildlife and plant growth.

(e) Avoid fast runoff of surface waters from developed areas to prevent pollutional materials such as animal feces, motor oils, paper, sand, salt and other debris, garbage and foreign materials from being carried directly into the nearest natural stream, lake or other public waters.

(f) Encourage a suitable system of ponding areas to permit the temporary withholding of rapid water runoff which presently contributes to downstream flooding and general water pollution giving preference to areas which contribute to groundwater infiltration and recharge, thereby reducing the need for public projects to contain, store and control such runoff.

(g) Provide sufficient land area to carry abnormal flows of storm water in periods of heavy precipitation, and to prevent needless expenditures of public funds for storm sewers and flood protection devices which proper planning could have avoided.

(h) Prevent the development of structures in areas unfit for human usage by reason of danger from flooding, unsanitary conditions or other hazards.

(i) Prevent the placement of artificial obstructions which restrict the right of public passage and use of the bed, bank and water of any creeks, marshes or watercourses within the Village.

"31.810. Definitions. For the purpose of this ordinance, the terms definded in this section shall have the following meanings:

(a) Obstruction means any dam, wall, wharf, embankment, levee, dike, pile abutment, projection, excavation, bridge, conduit, pole, culvert, building, wire, fence, fill, or projecting into the Flood Plain and Wetlands Conservation Area.

(b) Natural obstruction means any rock, tree, gravel or analogous natural matter that is an obstruction and has been located within the flood plain by a nonhuman cause.

(c) Artificial obstruction means any obstruction which is not a natural obstruction.

(d) Flood plain means the land area adjacent to a watercourse, drainage way or creek which has been or may be covered by flood waters.

"31.820. Definition and Establishment of Protected Area. The "Flood Plain and Wetlands Conservation Area" within the Village of Orono, hereinafter referred to as the protected area, is defined and established to be the low areas and flood plain adjoining and including any watercourse or drainage way or body of water subject to periodic flooding or overflow; and those areas designated and shown as marsh, wooded marsh, submerged marsh, inundation area, intermittent lake or intermittent streams by the United States Department of the Interior, through the Geological Survey on maps and supporting data designated as Mound Quadrangle, Minnesota, (NW/4 Lake Minnetonka, (1958) and Excelsior Quadrangle, Minnesota (NW/4 Lake Minnetonka, (1958),). Those maps are hereby made a part of this ordinance and two copies thereof shall remain on file in the office of the Village Administrator for public inspection. For purposes of defining the application of this map to any specific area, the maps, data and other available source material for this survey shall be on file in the office of the Village Administrator and shall be proof of the intended limits of the Flood Plain and Wetlands Conservation Area. Any change in the Flood Plain and Wetlands Conservation Area as may from time to time be determined to be proper shall be reflected on those maps.

"31.830. Development Prohibited.

(a) Prohibition. No filling, grading, dredging, excavation or construction shall be allowed within the Flood Plain and Wetlands Conservation Area; nor on lands abutting, adjoining or affecting said area if such activity upon those adjacent areas is incompatible with the policies expressed in this ordinance and the preservation of those wetlands in their natural state; nor shall land within the protected area be used in determining minimum area requirements for building sites except as provided in Section 31.841 herein. To specifically further define the specific boundaries of the Flood Plain and Wetlands Conservation Area as described in the official maps thereof, and to insure the policies in this ordinance are properly implemented, any persons undertaking improvements to or on any land abutting or adjacent to the protected area shall, prior to commencing the work, obtain a permit therefor from the Village of Orono. Approval may be expressly given in conjunction with other permits applied for, but no approval shall be implied from the grant of such permits nor from the necessity to apply for a permit as described herein.

(b) Variances. In extraordinary cases, variances may be granted upon application therefor, but only when the proposed use is determined to be in the public interest, and no variance shall be granted which the Council determines will or has a tendency to:

(1) Increase the height or duration of flood water in or along the Minnehaha Creek.

(2) Result in the placement of an artificial obstruction which will restrict the passage of flood water in such a manner as to increase the height of flooding, except obstructions approved by the Minnehaha Creek Watershed District in conjunction with sound flood plain management.

(3) Result in incompatible land uses or which would be detrimental to the protection of surface and ground water supplies.

(4) Increase the financial burdens imposed on the community through increasing floods and overflow of water onto land areas within this Village or onto land areas adjacent to Minnehaha Creek.

(5) Be not in keeping with land use plans and planning objectives for the Village of Orono or which will increase or cause danger to life or property.

(6) Be inconsistent with the objectives of encouraging land uses compatible with the preservation of the natural land forms, vegetation and the marshes and wetlands within the Village of Orono.

(7) Includes development of land and water areas essential to continue the temporary withholding of rapid runoff of surface water which presently contributes to downstream flooding or water pollution or for land and water areas which provide ground water infiltration which dimishes the land area necessary to carry increased flows or storm water following periods of heavy precipitation.

(c) Supporting Data. No permit or variance shall be issued unless the applicant, in support of his application, shall submit engineering data, surveys, site plans and other information as the Village may require in order to determine the effects of such development on the affected land and water areas. The applicant shall submit four copies of the application and the information. One copy shall be sent by the Village to the secretary of the Minnehaha Creek Watershed District. The District shall file its comments and recommendations with the Village within 20 days after receipt of the information, unless additional time is authorized by the Village.

"31.840. Land Development and Platting. No part of any lot within the Flood Plain and Wetlands Conservation Area shall be platted for residential occupancy or for other uses which will increase the danger to health, life, property or the public welfare. Whenever a portion of the Flood Plain and Wetlands Conservation Area is located within or adjoins a land area that is being subdivided, the subdivider shall dedicate an adequate easement over the land within the protected area and along each side of such area for the purpose of improving or protecting the area for drainage or other purposes expressed in this ordinance and other recreational uses. Public or private streets, driveways, drainage openings and culverts shall not be constructed unless the design thereof has been approved by the Village, and such structures shall be designed so as not to restrict the flow of water.

"31.841. Limited Credit Allowed. When land to be developed is connected to a public sanitary sewer line and includes land within the Flood Plain and Wetlands Conservation Area, the owner or developer thereof will be credited with an amount of his land within the Flood Plain and Wetlands Conservation Area equal to but not exceeding the amount of his adjacent land which otherwise qualifies for development under those ordinances for purposes of complying with the land use density, open space, building unit to land area ratios or other similar requirements of the land development and zoning ordinances of the Village except for requirements for recreational uses.

"31.850. Special Assessments. The land area in the Flood Plain and Wetlands Conservation Area which is not to be developed and which is dedicated as an easement shall not be subject to special assessments to defray the cost of other municipal improvement projects, including but not limited to trunk sanitary sewer and water mains and storm sewer improvements.

"31.860. Nuisance. Any filling, alteration, construction or artificial obstruction of the Flood Plain and Wetlands Conservation Area is declared to be and to constitute a public nuisance unless a permit to construct and maintain the obstruction has been obtained in the manner provided herein.

"31.861. Removal of Artificial Obstructions. If an artificial obstruction is found after investigation by the Village, an order shall be issued to the owner, following ten days written notice and hearing thereon, for removal within a reasonable time as may be prescribed by the condition and type of artificial obstruction. If the owner shall fail to remove the artificial obstruction or if the owner cannot be found or determined, the Village shall have the power to make or cause such removal to be made, the cost of which shall be borne by the owner or specially assessed against the lands in the same manner as prescribed by law for the levy of special assessments for municipal improvements notwithstanding Section 31.850 herein. The special assessment shall be certified to the county auditor for collection in the same manner as the ad valorem real property tax of the Village.

"31.870. Effect of Permit. The granting of a permit under the provisions of this ordinance shall in no way affect the owner's responsibility to obtain the approval required by any other statute, ordinance or regulation of any state agency or subdivision thereof.

"31.880. Penalties. Any person who violates the provisons of this ordinance shall be guilty of a misdemeanor and may be fined in such amount and be imprisoned for such time as authorized by law. Each day a violation exists shall be deemed a separate and distinct offense. The imposition of a criminal penalty shall not constitute a waiver of the right of the Village or others to secure removal of obstructions by injunction or other civil legal remedy.

"31.881. Separability. Every section, provision or part of this ordinances is declared separable from every other section, provision or part; and if any section, provision or part thereof shall be held invalid, it shall not affect any other section, provision or part.

Section 2. Section 31.700, 31.705 and 31.710 of Chapter 31 of the Municipal Code of Orono are hereby amended to read:

"31.700. Prohibition. It shall be unlawful for any person, firm or corporation to remove, fill, or use for fill, dredge, store or excavate rock, sand, gravel, dirt or similar material within the limits of the Village of Orono; to fill or reclaim any land by depositing such material or be grading of existing land so as to elevate or alter the existing natural grade; or to build, alter, or repair any seawall, retaining wall, to rip-rap or to otherwise change the grade or shore of lakeshore property without a conditional use permit issued by the Village Council. Granting of such permits is subject to other regulations and prohibitions of these ordinances, and other applicable statutes or ordinances of other governmental bodies.

"31.705. Permit. An application for such permit shall be accompanied by a drawing made by a registered surveyor or other competent person showing the location of the proposed excavation or storage and shall state the amount of material which is to be removed, excavated or stored, filled or graded, and such other information as the council may require from time to time. Applications shall be filed with the Village Administrator and shall be accompanied by a fee of $10.00 payable to the Village.

"31.710. Exception. The requirements of Section 31.700 are not intended to govern the normal and customary grading in the area of an existing or a newly constructed building, or the grading of the driveway serving such building. Such grading and earth moving shall be approved by the Building Inspector at the time of issuance of the Building Permit, providing that a plan showing proper drainage and protection of adjoining property has been submitted. Any unusual earth filling or removal of grading shall be referred by the Building Inpsector to the Planning Commission and Village Council for action in accordance with this ordinance.

Section 3. Section 39.150 of Chapter 39 of the Municipal Code of Orono is hereby amended to read:

"39.150. Flood Plain Areas and Wetlands. Areas within the Flood Plain and Wetlands Conservation Area will not be considered for subdivision purposes except in accordance with Sections 31.800 through 31.880 of this Code. Easements as required by Section 31.840 shall be granted by the subdivider.

Section 4. Review. This ordinance shall be reviewed two years from its effective date by the Council. At that time the Council shall review any development plans and studies of the Planning Commission and laws and ordinances of other governmental bodies which have reference to the policies and subject matter of this ordinance, and the Council shall consider whether amendments to the provisions of this ordinance can be made consistent with the purposes of this ordinance.

APPENDIX VI-b

Town of New Castle

Local Law No. 1 of the year 1972

A local law providing for the protection of wetlands, water bodies and water courses.

Be it enacted by the Town Board of the Town of New Castle, New York as follows:

Section I. PURPOSE

A. Rapid population growth attended by housing, road and other construction and increasing demands upon natural resources are found to be encroaching upon, despoiling, polluting or eliminating many of the Town's wetlands, water bodies, water courses, and other natural resources and processes associated therewith.

B. The preservation and maintenance of wetlands, water bodies and water courses in any undisturbed and natural condition constitute important physical, ecological, social, aesthetic, recreational and economic assets necessary to promote the health, safety and general welfare of present and future residents of the Town and of downstream drainage areas.

C. It is the intent of this Law to promote the public purpose identified in this Section by providing for the protection, preservation, proper maintenance and use of the Town's wetlands, water bodies and water courses by preventing or minimizing erosion due to flooding and storm water runoff, maintaining the natural ground water supplies, preserving and protecting the purity, utility, water retention capability, ecological functions, recreational usefulness and natural beauty of all wetlands, water bodies, water courses, and other related natural features of the terrain, and by providing, protecting and appropriating for natural wildlife.

Section II. DEFINITIONS

A. Conservation Council: The Conservation Advisory Council, or, if redesignated, the Conservation Board, of the Town of New Castle, New York.

B. Deposit: To fill, place, eject, discharge or dump any material but not including storm water.

C. Material: Soil, sand, gravel, clay, bog, peat, mud, debris, and refuse or any other organic or inorganic substance, whether liquid, solid or gaseous or any combination thereof.

D. Person: Any person, firm, partnership, association, corporation, company, organization or legal entity of any kind including municipal corporations, governmental agencies or subdivisions thereof.

E. Planning Board: The Planning Board of the Town of New Castle, New York.

F. Town Engineer: The Town Engineer or the Assistant Town Engineer of the Town of New Castle, New York.

G. Wetlands: Marshes, swamps, bogs and wet woodlands, whether (1) flooded at all times, (2) flooded only seasonally, or (3) have a water table, throughout at least 3 consecutive months of the year, within 6 inches of the ground surface.

H. Water Bodies: Any body of standing water which is not dry more than 3 months of the year as computed from the average of the last 2 consecutive calendar years and which, when wet, is customarily more than 500 square feet in water surface area.

I. Water Courses: Any body of flowing water flowing in an identifiable channel or course and which is not dry more than 3 months of the year.

Section III. PROHIBITED ACTIVITIES

Except as provided in Section IV of this law, the following activities shall be unlawful:

A. To deposit directly or indirectly or permit to be deposited any material into, within or upon any wetland, water body or water course, or within 40 feet of the edge of, any wetland, water body or water course.

B. To construct or permit to be constructed any building or structure of any kind within or upon any wetland, water body, or water course, or within 40 feet of the edge of any wetland, water body or water course.

C. To remove or permit to be removed any material from any wetland, water body or water course, or from any area within 40 feet of the edge of, any wetland, water body or water course.

Section IV. PERMITTED ACTIVITIES

A. Activities Permitted by Right.

The following activities are permitted, by right, within or adjoining any wetland, water body or water course, except where the Planning Board submits written notification to the property owner that is assuming jurisdiction over the activity for the purpose of assuring that the intent of this Law is not violated:

1. Outdoor recreation, including play and sporting areas; field trails for nature study, hiking or horseback riding; and swimming, skin diving, boating, trapping, hunting or fishing where otherwise legally permitted.

2. Grazing, farming, gardening and harvesting of crops where otherwise legally permitted.

3. Operation and maintenance of such dams, retaining walls, terraces, sluices, culverts and other water control structures or devices as were in existence on the effective date of this Law.

4. The cutting of brush and trees if there results therefrom no adverse affect upon a wetland, water body or water course.

5. This law shall not apply to any town-owned land which has been planned for development by the Town as of the effective date of this Local Law, including, without limitation, the Chamberlain Property and Gedney Park.

B. Activities Requiring Town Engineer Approval.

The following activities are permitted within or adjoining any wetland, water body or water course only if conducted pursuant to terms and conditions approved by the Town Engineer, except that Town Engineer approval shall not be required where the activity is conducted pursuant to terms and conditions of any application approved by the Planning Board.

1. Removing water-deposited silt, sand or other material in order to restore the pre-existing land elevations, provided the total quantity removed does not exceed 15 cubic yards of material.

2. Restoring land elevations that have been altered by erosion or storm damage.

3. The construction, expansion or improvement of private recreation facilities, as otherwise legally permitted, provided the amount of material deposited, removed or regraded does not exceed 15 cubic yards.

4. The construction of driveways where alternative means of access are proven to be impractical, provided the amount of material to be deposited or regraded in connection with such construction does not exceed 100 cubic yards.

5. The use of chemicals, dyes or other similar materials to maintain any wetland, water body or water course provided that approval shall be given only after consultation with or pursuant to the guidelines of the Conservation Advisory Council.

6. Any activity requiring Planning Board approval by the terms of this law which the Board refers to the Town Enginner for his disposition.

C. Activities Requiring Planning Board Approval.

The following activities are permitted within or adjoining any wetland, water body or water course, subject to approval by the Planning Board as a part of a subdivision application, a site development plan application, or an application submitted pursuant to the procedure set forth in Section V of this Law, provided that the activity shall be conducted in such manner as will enhance or cause the least possible damage, encroachment or interference with the natural resources or functions of the wetland, water body or water course, consistent with the purpose of this Law.

1. Any activity listed in Item B of this Section, but involving a scale of operation beyond that which is approvable by the Town Engineer.

2. Any activity normally permitted by right or normally requiring Town Engineer approval as set forth in Items A and B of this Section, where the Planning Board notifies the property owner in writing of the Board's intent to assume jurisdiction in furtherance of the purposes set forth in this Law.

3. The construction of roads, where alternative means of access are proven to be impractical.

4. The construction of municipal or utility uses such as water supply facilities, park and recreation facilities, sewage treatment facilities or other installations whic involve any alteration of existing natural conditions in, or within 40 feet of the edge of any wetland, water body or water courses.

5. Utility lines.

6. Any activity otherwise prohibited by this Law may be permitted by the Planning Board to be done provided the Planning Board determines after investigation, that to prohibit such activity would cause unreasonable hardship to the property owner and that, in such particular instance, the proposed activity would not be adverse to the purpose of this Ordinance as set forth in Section I.

Section V. PERMITS

A. Applications

Applications for permits to conduct any of the activities permitted by Section IV-B shall be submitted to the Town Engineer in two copies and applications for permits to conduct any of the activities permitted by Section IV-C shall be submitted to the Planning Board in four copies, including the following information:

1. Name and address of applicant and of applicant's agent, if any, and whether applicant is owner, lessee, licensee, etc. If applicant is not owner, the written consent of the owner must be attached.

2. The specific purpose, nature and scope of the activity proposed.

3. Any topographical and perimeter surveys, hydrological computations, engineering studies and other factual or scientific data and reports as deemed necessary by the approving authority (Planning Board or Town Engineer) to permit it to arrive at a proper determination.

4. Applications affecting water retention capability, water flow or other drainage characteristics of any wetland, water body or water course shall include a statement of the area of upstream and downstream watersheds, impact analysis and information as to rainfall intensity in the vicinity for not less then ten year return frequency, together with approximate runoff co-efficients to determine the capacity and size of any channel sections, pipes or waterway openings, together with plans for necessary bridges, culverts storm water or pipe drains that, in the opinion of the approving authority, are needed to arrive at a proper determination on the application, consistent with the purposes of this Law.

B. Referral to Conservation Advisory Counsel.

The Planning Board or Town Engineer may refer any application submitted pursuant to this Law to the Conservation Advisory Council for review and report. The Conservation Advisory Council shall report back to the Planning Board or to the Town Engineer as the case may be, within thirty (30) days of the date or referral or within such other period as may be specified by the Planning Board at the time of referral. Failure to reply within the specified time period may be interpreted by the Planning Board as indicating no objection to the application.

C. Public Hearing.

The Planning Board may, at its discretion, advertise and conduct a public hearing on any application submitted pursuant to this Law, with the same notice as required by law for subdivision applications.

D. Time Period.

Within 75 days of the date of the Planning Board meeting at which an application submitted pursuant to the requirements of this Law, is received by the Planning Board, or within 45 days of the date of any public hearing which may be conducted on said application, whichever period is shorter, the Planning Board shall render a decision to approve, approve with modifications, or disapprove the issuance of a permit for the proposed activity.

E. Conditions and Time Limit.

In approving any application submitted pursuant to the requirements of this Law the approving authority may impose such conditions on the proposed activity as it determines necessary to ensure that the intent of this Law is complied with. The approving authority may fix a reasonable time within which any operations must be completed and may also require the filing with the Town Board of cash or surety company performance bond in such amount and form as determined necessary by the approving authority to ensure compliance with the approved permit.

F. Disposition by Town Engineer.

The Planning Board, at its discretion, may waive its power of review and approva in cases where the Board determines that the proposed nature or scope of activity is such that the application should be handled administratively by the Town Engineer. In such cases, the Board shall direct the Town Engineer to decide the matter in accordance with the normal administrative procedures for applications submitted pursuant to the requirements of Section IV-B of this Law.

Section VI. FEES

After a permit shall have been granted by the Planning Board and as a condition for the issuance thereof, the applicant shall pay a fee of $10.00 to said Board. No fee shall be required for permits issued by the Town Engineer in accordance with the requirements of this Law.

Section VII. CONFLICTS WITH OTHER STATUTES

This Law shall not apply to any work shown on construction drawings or improvement plans for subdivision heretofore approved by said Planning Board.

Nothing contained in this Law shall supersede the prohibitions or restrictions contained in the Conservation Law of the State of New York or the provisions of the Westchester County Stream Control Law which is known as Title D, Article 9, of the Westchester County Administrative Code, but shall be considered to be in addition thereto.

Section VIII. PENALTIES

For any and every violation of the provisions of this Law, either or both of the persons committing the same and the owner of the premises where such violations have been committed, shall be guilty of an offense punishable by a fine of not to exceed One Hundred ($100.00) Dollars for each separate identifiable violation and for each week's continued violation.

Section IX. PARTIAL INVALIDITY

If any provision of this Law shall be held for any reason to be invalid, such determination shall not invalidate any other provision hereof.

Section X. EFFECTIVE DATE

This Law shall take effect immediately.

APPENDIX VI-c

TOWN OF DARTMOUTH, MASSACHUSETTS

WETLANDS ZONING BY-LAW

(EXCERPT)

ADOPTED JUNE 11, 1973

Section 6. Superimposed Districts

A. Interpretation and Application

Any proposed use to be located within the limits of the Inland Wetlands and Watershed Protection District or the Coastal Wetlands District, as determined by the Building Inspector under Section 9 of the By-Law, shall be governed by all regulations set forth in this section as well as all other applicable provisions of this By-Law. Where a proposed use is determined to fall within the limits of the Inland Wetlands and Watershed Protection District or the Coastal Wetlands District, but the applicant for the proposed use determines that the location for this proposed use is not wet or subject to periodic flooding and should not therefore be included in the definition of the Inland Wetlands and Watershed Protection District or the Coastal Wetlands District, may be exempt by the Board of Appeals from the provisions of this section if he provides sufficient evidence for the Board of Appeals to clearly determine that the land in question should not be subject to the provisions of this Section.

B. Inland Wetlands and Watershed Protection District

(1) Purpose of District. The purpose of this district is:

(a) To preserve and protect the streams and other water courses in the Town of Dartmouth and their adjoining lands.

(b) To protect the health and safety of persons and property against the hazards of flooding and contamination.

(c) To preserve and maintain the ground water table and water recharge areas for water supply purposes.

(d) To protect the community against the detrimental use and development of lands adjoining such water courses.

(e) To conserve the watershed areas of the Town of Dartmouth for the health, safety, and welfare of the public.

(f) To assure the continuation of the natural flow pattern of the water courses providing safe and adequate flood water storage and runoff capacity.

(3) Definition of District. The Inland Wetlands and Watershed Protection District is superimposed over any other district established by this By-Law.

(a) All lands in Darmouth which have been identified as being fresh marsh (FM), deep marsh (DM), shrub swamp (SS), wooded swamps (WS), cranberry bog (CB), and ponds (P) are included in the Inland Wetlands and Watershed Protection District and are indicated on the Natural Resources Map.

(b) All land area along the rivers and brooks for a horizontal distance of 50 feet from the center line thereof are included in the Inland Wetlands and Watershed Protection District and are indicated on the Natural Resources Map. The names of the rivers and brooks included in the district are as follows: Shingle Island River, Copicut River, Destruction Brook, and Paskamansett River.

(4) Permitted Use. Municipal use, such as Waterworks, pumping stations, essential services and parks, is permitted under this section. Land in the Inland Wetlands and Watershed Protection District may be used for any purpose otherwise permitted in the underlying district except that:

(a) No structure intended for human occupancy or use on a permanent basis having water and sewerage facilities and no other building, wall, dam or structure (except flagpoles, signs and the like) intended for permanent use shall be erected, constructed, altered, enlarged or otherwise created or moved for any purpose unless a Special Permit from the Board is issued. However, without a Special Permit, a structure existing at the time this By-Law becomes effective may be reconstructed or repaired after a fire, hurricane, flood or other casualty or natural disaster and a dwelling or building accessory to a dwelling existing at the time this By-Law becomes effective may be altered or enlarged provided no other provisions of these By-Laws are violated.

(b) Dumping, filling, excavating or transferring of any earth material within the District is prohibited unless a Special Permit from the Board is issued. However, this paragraph does not prohibit ordinary gardening activities in lawn or garden areas which are used for such purposes at the time this By-Law becomes effective.

(c) No ponds or pools shall be created or other changes in water courses, for swimming, fishing or other recreational uses, agricultural uses, scenic features, or drainage improvements or any other uses unless a Special Permit from the Board is issued.

(5) Permit and Procedure. Any person(s) desiring such a permit shall submit an application to the Board of Appeals which shall comply with the conditions and submittal requirement as listed in the following subsections. (Such conditions shall include, where applicable, approval by the Conservation Commission, the Massachusetts Department of Natural Resources, and the Massachusetts Department of Public Works under Chapter 131 of the General Laws, acts relating to the protection of the inland wetlands of the Commonwealth.) The application procedure shall be the same as for special permits. Copies of the application for special permit to the Board with accompanying plans shall also be sent to the Building Inspector, Board of Health, the Conservation Commission, and the Planning Board for their recommendations to the Board, as to their approval, disapproval or appropriate recommendations.

(6) Required Submittals

(a) Submission of a location plan at a scale of 1" = 1,000' showing the lot(s) lines within which the development is proposed, and tie-in to the nearest road intersection.

(b) A site plan at a scale 1" = 40' shall prepared by a registered professional engineer. The site plan shall be submitted to the Board and shall show at least the following:

i. The location boundaries, and dimension of each lot in question.

ii. Two foot contours of the existing and proposed land surface.

iii. The locations of existing and proposed structures, watercourses, and drainage easements, means of access, drainage, and sewage disposal facilities.

iv. The elevation of the basement and first floor.

v. The area and location of leaching fields.

(7) Development Conditions. For the development of land within the Inland Wetlands and Watershed Protection District, the following conditions shall apply:

(a) the lot(s) may be served by a public water system or an individual well supply may be developed.

(b) If the lot(s) is to be served by a public sewerage system, the following conditions shall apply:

i. A minimum of six test borings to a minimum depth of eight feet shall be taken; three of which shall be within the area of the proposed structure and three within 25 feet of the outside walls of the structure, but not closer than ten feet. A report by a soil scientist or qualified engineer shall accompany the test data.

ii. The floor level of areas to be occupied by human beings as living or work space shall be four feet above the seasonal high water table and not subject to periodic flooding.

iii. If the basement floor level is below the seasonal high water table and affords the possibility of human occupancy at some future date, although not originally intended, adequate perimeter drainage and foundation shall be installed to withstand the effect of pressure and seepage. Furnace and utilities are to be protected from the effects of leaching.

iv. Safe and adequate means of vehicular and pedestrian passage shall be provided in the event of flooding of the lot(s) or adjacent lot(s) caused by either the overspill from water bodies or high run-off.

(c) If the lot(s) is to be served by an on-lot septic system, the following conditions including those listed previously shall apply:

i. The leaching area designed for use, as well as a reserved area for future expansion or total future use, shall be plotted with dimensions on the site plan.

ii. A minimum of two percolation tests per leaching areas shall be performed. The maximum groundwater table shall be determined during the last two weeks of March or the first three weeks of April. At least two deep observation pits shall be dug to determine soil profiles. The observation pits may be dug during other times of the year, and shall be accompanied by a detailed report compiled by a soil scientist or qualified engineer.

iii. The leaching areas shall not be constructed in areas where the maximum groundwater elevation is less than four feet below the bottom of the leaching area.

(d) The developer shall show that the proposed development will not endanger health and safety including safety of gas, electricity, fuel, and other utilities from breaking, leaking, shortcircuting, grounding, igniting or electrocuting, obstruct or divert flood flow; substantially reduce natural floodwater storage capacity, destroy valuable habitat for wildlife, adversely affect groundwater resources or increase stormwater runoff velocity so that water levels on other land are substantially raised or the danger from flooding increased.

(8) Board of Appeals Procedure

(a) The Board of Appeals shall not take final action on an application for a special permit hereunder until it has received a report thereon from the Building Inspector, the Board of Health, the Conservation Commission, and the Planning Board, or until 30 days have elapsed after receipt of such plan without the submission of a report.

The Board of Appeals shall give due consideration to all reports and, where its decision differs from the recommendations received, shall state the reasons therefor in writing.

(b) The Board may, as a condition of approval, require that effective notice be given to prospective purchasers, by signs or otherwise, of past flooding of said premises, and the steps undertaken by the petitioner or his successor in title to alleviate the effects of the same.

(9) Occupancy Permit. No occupancy permit shall be issued until the Board, the Building Inspector, the Board of Health, the Conservation Commission, and the Planning Board have received a certified plan showing the foundation and floor elevations, grading of the premises, elevations of the completed construction and all elevations of the various elements that make up the sewage disposal system, and that all requirements of all permits are satisfied.

(10) Areas and Yard Regulations. A lot, a portion of which is in the Inland Wetlands and Watershed Protection District, meets minimum area regulations under Section 7 (Renumbered) of this By-Law provided that not more than 20 percent of the lot area which is required to meet the minimum requirements of the zoning district is within the Inland Wetlands and Watershed Protection District.

C. Coastal Wetlands District.

(1) Purpose of the District. The purpose of this district is to promote:

(a) The health and safety of the occupants of lands subject to seasonal or periodic tidal flooding.

(b) The preservation of the salt marshes and tidal flats and their attendent public benefit including the preservation of marine life.

(c) The safety and purity of water; control and containment of sewage; safety or gas, electric, fuel and other utilities from breaking, leaking, shortcircuiting, grounding, igniting, electrocuting or any other dangers due to flooding.

(d) The protection of lands against erosion and movements of coastal sediments.

(2) Definition of District. The Coastal Wetlands District is superimposed over any other districts established by the By-Law.

(a) All lands in Dartmouth which have been identified as being barrier beach (BB), tidal flat (TF), and salt marsh (SM), which includes salt meadows, irregularly flooded and regularly flooded salt marshes are included in the Coastal Wetlands District and are indicated on the Natural Resources Map.

(3) Permitted Uses. Municipal uses such as wastewater treatment facilities, water works, pumping stations, essential services, and parks are permitted in this district. Land in the Coastal Wetlands District may be used for any purpose otherwise permitted in the underlying district except that:

(a) No structure intended for human occupancy or use on a permanent basis having water or sewerage facilities, and no other building, wall, dam, or structure (except flagpoles, signs and the like) intended for permanent use shall beerected, constructed, altered, enlarged, or otherwise created or moved for any purpose except for piers, boathouses, walkways, and similar facilities which may be granted by a Special Permit from the Board. However, without a Special Permit, a structure existing at the time this By-Law becomes effective may be reconstructed or repaired after a fire, hurricane, flood or other casualty or natural disaster and a dwelling or buildings accessory to a dwelling existing at the time this By-Law becomes effective may be altered or enlarged provided no other provisions of these By-Laws are violated.

(b) Dumping, filling, excavating, or transferring of any earth material within the District is prohibited. However, this paragraph does not prohibit ordinary gardening activities in lawn or garden areas which are used for such purposes at the time this By-Law becomes effective.

(c) No ponds or pools shall be created or other changes in water courses, for swimming, fishing, or other recreational uses, marine agricultural uses, scenic features or drainage improvements or any other uses unless a Special Permit from the Board is issued.

(d) No use shall be permitted to develop in such a manner as will adversely affect the natural character of the area.

(e) No provision of the By-Law shall supersede licenses or permits in force at the time of passage of this By-Law.

(4) Permit and Procedure. Any person(s) desiring such a permit shall submit an application to the Board which shall comply with the conditions and submittal requirement as listed in the following subsections. (Such conditions shall include, where applicable, approved by the Conservation Commission, the Massachusetts Department of Natural Resources, and the Massachusetts Department of Public Works under Chapter 131 of the General Laws, Acts Relating to the Protection of the Coastal Wetlands of the Commonwealth.) The application procedure shall be the same as for special permits. Copies of the application for Special Permit to the Board of Appeals with accompanying plans shall also be sent to the Building Inspector, Board of Health, the Conservation Commission, and the Planning Board for their recommendations to the Board as to their approval, disapproval or appropriate recommendations.

(5) Required Submittals.

(a) Submission of a location plan at a scale of 1" = 1,000' showing the lot(s) to be developed, lot lines within which the development is proposed, and tie-in to the nearest road intersection.

(b) A site plan at a scale of 1" = 40' shall be prepared by a registered land surveyor or a registered professional engineer. The site plan shall be submitted to the Board and shall show at least the following:

i. The location, boundaries, and dimension of each lot in question.

ii. Two-foot contours of the existing and proposed land surface.

iii. The location of existing and proposed structures, watercourses, and drainage easements, means of access, and drainage.

(6) Board of Appeals Procedure.

(a) The Board shall not take final action on an application for a special permit hereunder until it has received a report thereon from the Building Inspector, the Board of Health, the Conservation Commission, and the Planning Board or until 30 days have elapsed after receipt of such plan without submission of a report. The Board shall give due consideration to all reports and, where its decision differs from the recommendations received, shall state the reasons therefor in writing.

(b) The Board may, as a condition of approval, require that effective notice be given to prospective purchasers, by signs or otherwise, of past flooding of said premises, and the steps undertaken by the petitioner or his successor in title to alleviate the effects of the same.

(7) Occupancy Permit. No occupancy permit shall be issued until the Board, the Building Inspector, the Board of Health, the Conservation Commission, and the Planning Board have received a certified plan showing the foundation and flood elevations, elevations of the completed construction, and that all requirements of all permits are satisfied.

(8) Areas and Yeard Regulations. A lot, a portion of which is in the Coastal Wetlands Districts meets minimum area regulations under Section 7 (Renumbered) of this By-Law provided that not more than 20 percent of the lot area which is required to meet the minimum requirements of the zoning district is within the Coastal Wetlands District.

SECTION VII

WOODLANDS

A. Introduction

Though there seem to be plenty of woodlands, human impacts on the American forest are extensive. Only isolated, undisturbed traces, for example, remain of the great eastern deciduous forest which stretched almost unbroken from the Atlantic to the Mississippi River and from southern Canada to the Gulf of Mexico. Land cleared for settlement, timber, and agriculture destroyed much of this extensive forest from the 17th to the 19th centuries. With continued dense settlement in the east, the forest has been largely restricted to mountainous regions, where it is now protected in national and state parks and forests.

Much of today's eastern forest is second-growth timber on abandoned farmland. In 1820, for example, during the period of most intensive agriculture in New England, forests accounted for only 25 per cent of the area of Connecticut. Today that area is 64 per cent. Within the relatively short period of a century, the forest has returned to vast stretches of the east. Similarly, much of the western forests have been altered by fire and timber harvesting. Grazing, scant soil cover, and the relatively slow rate of growth in western forests (one-third that of eastern forests) make replacement of these forests a more difficult process. Yet in the west, too, second- and third-growth woodlands are common.[1]

Though markedly different from the original woodlands, these second- and in some cases third-growth forests are nevertheless of incalculable value to us for timber, wildlife habitat, recreation, and aesthetic enjoyment. While larger acreages are protected by federal and state preserves, significant parts of our woodlands are once again under potential threat, this time chiefly from poorly planned housing and suburban development, rather than lumber and agricultural development.

Not only the recrational, aesthetic, and economic benefits of woodlands suffer from poorly regulated use. Other less familiar benefits of forests are also harmed. Woodlands are important moderators of climatic phenomena such as flooding and high winds, and thus protect watersheds from the siltation and erosion resulting from heavy runoff or wind. The forest floor also acts as a filter to water percolating into groundwater reservoirs, and the forest itself can improve air quality by absorbing some air pollutants. Moreover, woodlands moderate local climatic changes, most significantly by providing more moderate temperatures in contrast to the fluctuation between hot days and chilly nights in open areas such as fields, suburbs, and cities.

The names of our suburbs--Forest Hills, Oaklawn, and Park Forest--indicate how much we value a wooded environment. The relatively high real estate value of wooded areas is a partial reflection of our preference for woodland residences, but it does not necessarily play a crucial role in development decisions. Since woodlands adjacent to urban centers afford prime land for development, the high real estate value depends more on location economics than it does on the environmental benefits of woods. If location is a crucial factor, then the builder can maximize his profits by reducing the construction costs by clearing the land and still attracting buyers. The prospective purchaser makes his decision based upon what he sees, not what he might have seen or could yet see if the land had been developed to protect wooded areas.

Clearcut land poses fewer problems for current design and construction practices. Streets and sewer lines can run across the land in regular patterns without making necessary modifications for certain stands of trees or natural elevations and depressions in the landscape. Cutting the trees and smoothing out the bumps and holes is far easier than building around such natural obstacles. Part of the problem, however, is also consumer preference. Single-family, detached housing projects that dominate the suburban market require far more land area on which to build than other housing alternatives, such as cluster development. In these higher-density developments housing can be scattered within a large wooded area and thus require the disturbance of far less land surface. One could then imagine pockets of development within forested areas.

As we create and implement policies designed to protect and conserve suburban and rural woodlands, we should consider several factors.

1. Although most woodlands are very resilient and capable of replacing themselves after they have been cut or disturbed, their process requires many decades and, in some cases, centuries. Moreover, the second- or third-growth forest may be of different composition than the one it replaced. It can, for example, be composed of weedy trees and shrubs that are unsuitable for recreation and wildlife habitat or too unstable to provide other benefits

of woodlands. Thus, before allowing the cutting or development of a woodland, we must consider these factors of the time required for replacement and the quality of the replacement vegetation.

2. Of course not all forests can or should be saved from development, and in some cases a community may not care whether a new forest later replaces the old one. Thus, we must weigh the public benefits of woodland as it is against the proposed use of the land, whether for housing developments or farmland. The choice need not be so clearly woodlands or none at all. With regulated land-use policies we can use woodlands for many purposes and still conserve enough of the original woods to benefit from them as well.

3. Finally, we should make a decision between continuing to allow the short-run exploitation of our woodlands for immediate profit and the long-run use of them which depends upon development compatible with woodland ecology.

B. Forest Ecology and the Public Purpose in Maintaining Its Health

The question is not whether we will develop woodlands; it is rather how that development will occur. One look at a community which allowed the irresponsible development of its woodlands shows that the public interest in woodland protection extends far beyond aesthetics. Increased erosion and siltation, lessening of water quality, loss of landscape diversity, increased dangers from flooding, and decreased land values are all possible results of poorly planned woodland development. Cutting the forest can also change the surrounding ecology of wildlife and associated herbs and shrubs completely.

Though most suburban forests, because of their size and the proximity of housing and commercial development, are unsuited for the economic uses of tree forestry, they have equally important value to the community, even if it cannot be measured in board feet. Maintaining overall environmental health, providing watersheds and soils, improving water and air quality, buffering the noise and sights of civilization, and modifying the climate of the urban environment are some of the woodland's greatest benefits.

1. Woodlands provide a varied and rich environment of many kinds of plants and animals. The different layers of tree tops, branches, trunks, shrubs, and plants on the forest floor provide breeding, feeding, and refuge areas for many species of insects, birds, and mammals. This environmental diversity of woodlands is an important resource for wildlife conservation and general environmental health and is crucial to our enjoyment of them for recreation, hunting, and fishing.

2. Woodlands protect and conserve important resources such as watersheds and soils. Forest vegetation moderates the effects of winds and storms, stabilizes and enriches the soil, and slows runoff from precipitation, thereby allowing it to be filtered by the forest floor as it soaks down into groundwater reserves. By decreasing runoff and increasing groundwater infiltration, woodlands also protect a community from flooding.

3. Woodlands are buffers to the sights and sounds of civilization. Woodlands mute the noise from freeways and factories, as well as absorb some air pollutants.

4. Woodlands are moderators of climatic extremes. The microclimate of a forest, created in part by the shade of the trees and the transpiration of water from the leaves, keeps surrounding air at an even temperature. Forest temperatures are generally cooler in the day and warmer at night than the more widely fluctuating temperatures of unforested areas. Woodlands adjacent to and interspersed among suburban and urban areas thus act as natural air conditioners.

1. Woodlands and Environmental Health and Diversity

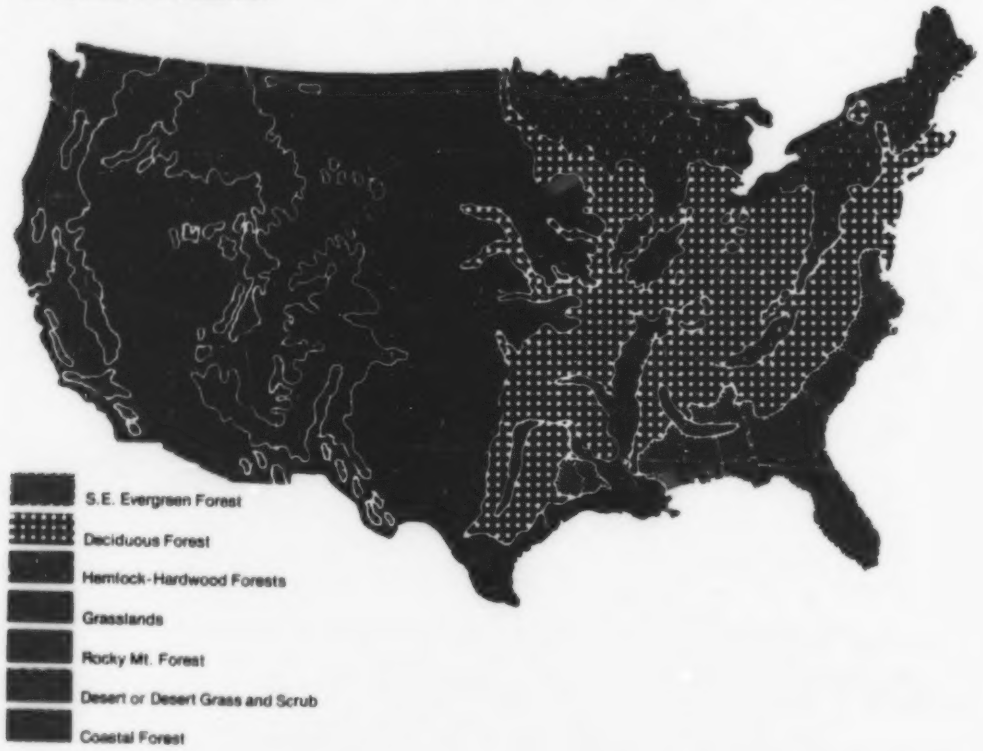
Woodlands vary greatly depending upon climate, topography and soils. Some trees do not thrive under the same environmental conditions as others and it is this difference which accounts for the marked changes in forest composition that one notices in travelling from river bottoms to hill tops or from north to south.

In the United States there are two major forest biomes or forest types: the boreal forest of the extreme north and elevated regions, composed of coniferous evergreens, and the deciduous forest of warmer, more southern and eastern areas. Where these two biomes overlap, the transition zone between them is a mixture of coniferous and deciduous trees. The deciduous forest itself is a wide mixture of various species dependent for their occurrence upon local environmental conditions. It grades from river bottom lowlands of poplars and willows, to midlands of beech, maple, basswood, black cherry, oak, and pine, to dry uplands of other oaks, hickory, and juniper.

The boreal forest extends above the deciduous forest from New England and New York north into Canada and as far south as Mexico in the Rockies and Sierras. In the east it begins as pine and hemlock mixed with deciduous species in the ecotone, to spruce and fir farther north at higher elevations,until it reaches the typical boreal forest of douglas, balsam fir and white spruce. A variant of the boreal forest is the lavish vegetation of the Pacific Coastal forests with sitka spruce, douglas fir,and redwoods. The alpine forests of the western mountains are another variant where douglas fir and ponderosa pine grow at lower elevations with other conifers in the higher elevations. Within these conifer forests are large stretches of deciduous quaking aspen, the most widespread tree in North America, occurring throughout most of the western and northern coniferous forests.[2] Figure VII-I shows the general occurrence of these forest types in the United States.

Not only do these forests differ greatly according to elevation, latitude, topography,and other environmental factors, they also differ according to the stage of development. Any given set of environmental conditions has a more or less stable community of flora and fauna adapted to it. This community is capable of reproducing itself and maintaining its identity, provided that environmental factors remain constant. Though they are stable in an undisturbed state, fire, human disturbance, or other alterations in climate or environment can disrupt the stable community by creating conditions more favorable to other species.

Figure VII-1[3]



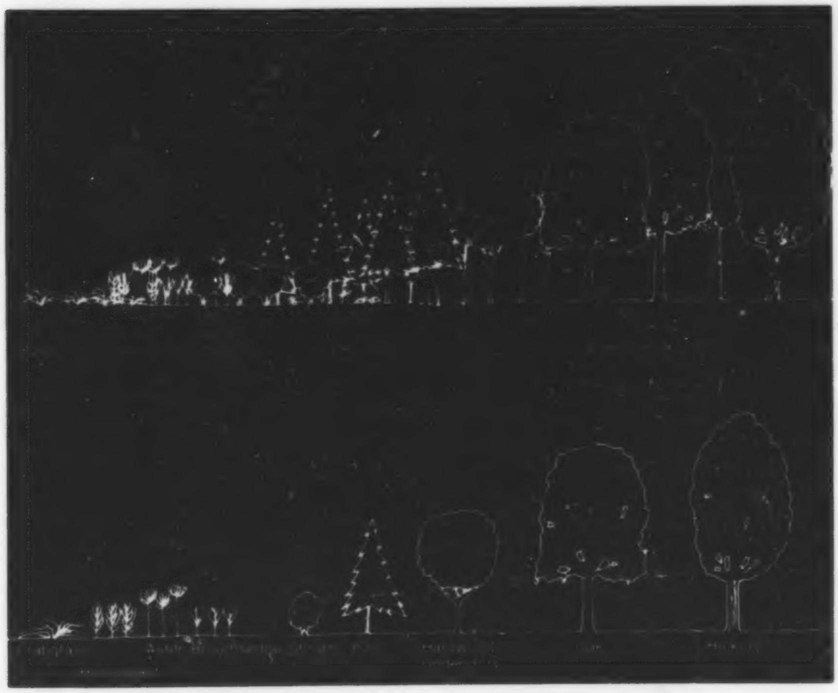
The Vegetation of the United States

Map of the climatic plant formations of the United States.
In the east the forest boundaries are those of about a century ago.

We most often encounter forests that are not stable. These are woodland communities that are undergoing a slow and gradual transition from one forest community to another. (See Figure VII-2.) To understand this concept of succession, we might consider a theoretical situation in the eastern deciduous forest. A stable forest of maples, basswoods, and elms is cut down for timber and agricultural land. Later the farming stops and an old field

Figure VII-2[4]

Succession: from bare field to Oak-Hickory woodland



community of grasses, sedges, and herbs, such as thistle and goldenrod, which tolerate disturbed conditions, comes in. These pioneer or first-stage plants are replaced later by windblown seeds of aspen and cottonwood, still later by animal-carried seeds of oaks and hickories, and perhaps even later by the seeds of the maples and other species which composed the original forest.

A key factor affecting this succession of species is shade tolerance. Maples and basswoods are able to grow in their own shade as well as that of the oaks and hickories, but not vice versa. Thus, once maples and similar trees reach full size, other species cannot grow or reproduce in their shade. Other areas have different patterns of succession and different factors operate there, such as availability of seed and method of seed dispersal. Of course changes in soils and climate can alter the theoretical succession pattern.

In many places the effects of man interrupt and change the stages of succession. Such is the case in the pine forests of the southern U.S., where fire and cutting have maintained an intermediate state of succession to the dominant oak, hickory, and magnolia woodlands. This forest of short- and long-leaved pines and many similar areas, such as golf courses, pasture lands, and tree farms, where human intervention maintains a given community, are communities where economic rather than environmental considerations determine the stable community.

Succession patterns and the composition of forest communities depend upon local conditions, so that a stable community in one area may be only a transitional one elsewhere. But generally speaking, in the boreal forest jack pine, aspen, birch,and poplar pioneer in disturbed areas, whereas cottonwood, aspen, birch, oak, and hickory pioneer in disturbed areas in the deciduous forest. It is important to understand that the pattern of succession is a process that occurs over a long period of time, perhaps hundreds of years or more from pioneer to stable state. Since this length of time makes a stable forest unique within the span of an average person's lifetime, it is of considerable value. When one considers the possibility that environmental conditions and soil may so change in the process of succession that a disturbed virgin forest or even second-growth stable forest may never regain their hold in an area, once they are gone the value of such forests becomes even more apparent. Protection of stable forests, because of their uniqueness, is important in preserving environmental diversity. But other rare areas, such as relic areas, should also be considered for special protection. Relic woodlands are forest communities adapted to former environmental conditions that because of unique local conditions have survived the environmental change. In southern Wisconsin, for instance, the trees adapted to the cooler climate which followed the last glaciation retreated to the cooler, moist uplands as the climate became drier and warmer. These shaded glens of hemlock and fern resemble the forests of the Appalachian and on a national scale are not particularly rare. However, in southern Wisconsin's landscape of oak savannahs, pine barrens and grazing lands, such woodland communities are indeed rare and represent important biological banks upon which the land may draw if climatic conditions change once again to favor these moister, cooler woodland types.

Disturbance of woodland communities and the great variety of paths succession may take assure a constant diversity in the composition of forests. Yet rapid, severe, and widespread disturbance is a phenomenon associated with the activities of man and can do serious damage to the natural process involved. Soils can leach or erode away from constantly disturbed areas, altering the soil chemistry and nutrient availability; and species diversity can be simplified by widespread disturbance, thereby limiting the possible replacement trees in successive stages. We must learn to take these natural factors into account as we inevitably disturb forest communities.

The power of human disturbance to alter the natural process of succession is important to remember in making decisions to develop a woodland. Near heavily developed urban areas the unavailability of seed from scattered trees may seriously impair the restoration of severely disturbed forests. Thus preserving stands of trees for natural reseeding is an important conservation measure in heavily developed areas. Otherwise, the forest must be artificially restored. Though this is not expensive, it is difficult to artificially reproduce the natural process of succession, and second-growth forests of less stability and diversity may result.

The time required for succession is a particularly important factor in the western forest. It takes 200 years for a stable community to develop in Colorado as opposed to 50 years in Virginia. The slower rate of growth in western forests as well as the smaller variety of plants accounts for this difference. In these areas and others such as hilly or mountainous regions or locations where the soil mantle is very thin, disturbance of woodlands can remove protective vegetation, allowing the soil to erode to such a degree that reforestation is very difficult. This is a particular problem in many western states. In some southern states, where easily compacted clays underlie woodlands, removal of vegetation can result in severe erosion of the scant topsoil and compaction of the clay,so that the growth of pioneering vegetation is severely impaired.

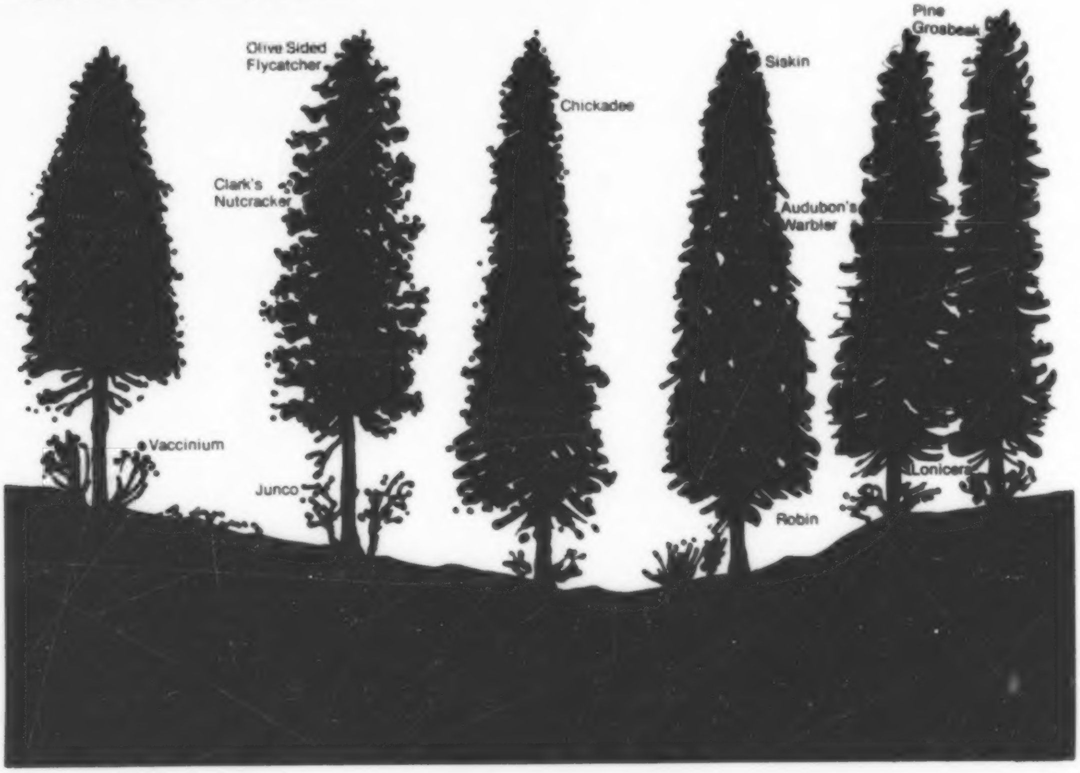
Though trees are inevitably considered the chief ingredients of forests, there are of course many other plants as well as animals that compose the woodland ecosystems. The yearround shade and poorly decomposed acid soil produced by coniferous forests prohibit development of substantial undergrowth, but there is a small group of herbs and shrubs growing under conifers. The deciduous forest, with its rich,decomposed soil and periods in spring and fall when sunlight reaches the forest floor, shows the greatest diversity of undergrowth. Here shrubs thrive, as well as a wide variety of spring and fall wildflowers.

The stratification of the forest into a top or canopy, one or two intermediate layers or understories, and the ground layer of herbaceous plants provides a rich and varied environment for many species of wildlife. Figure VII-3 shows how such stratification in the spruce-fir forest in Wyoming provides a variety of foraging environments or niches for many bird species. Though there is little understory vegetation, the dense branches of firs and spruce provide many different niches.

The variety of bird life is the clearest example of how feeding and breeding niches are afforded by forest structure. Some birds nest and feed on the ground, others in the shrubs, and still others in the upper branches of the trees. Bark, leaves, and leaf litter provide them with different feeding areas. This diversity of feeding and breeding areas allows a great variety of birds to utilize the common resources of the forest without being in direct competition for them.

Figure VII-3[5]

Foraging niches of some birds in a spruce-fir forest



Other animals use the forest for cover, breeding, and feeding. Large animals such as the timber wolf, grizzly bear, and mountain lion need large undisturbed areas of forest to survive. Others, such as deer, racoon, mink, skunk, oppossum, and shrew are common in less dense woodlands. In the summer the ground and vegetation support a great variety of invertebrates, amphibians, and reptiles, from the earthworms which aerate the soil with their tunnels to the frogs breeding by the spring pools.

In many areas of the west, and in a few regions of the north-central and eastern states, there are still relatively healthy populations of large predator animals, such as bobcats and wolves. These mammals require large areas of forested territory for their feeding and breeding habits. It is important in planning development to maintain linear paths that allow these animals to move over large areas of land. While we think of them as ferocious beasts, they are very important to maintaining the health and stability of the forest. In the north-central states, for instance, large predator animals, mainly wolves, were exterminated at the turn of the century, allowing the deer population, on which they preyed, to explode. With no natural predator, deer multiplied to such an extent that thousands starved and many others so severely browsed the fir forests that extensive damage was done to the lumber industry. Even the artificial predation of deer hunting has not been sufficient to control the deer, and some north-central states, notably Michigan, are reintroducing timber wolves.

Similar problems have occurred in other areas where animals like rabbits overpopulate once the natural control of predation has been lost by extermination or human disturbance of their environments. Loss of insect predators, such as many bird species, is an equally serious problem. In recognizing the importance of maintaining the natural balance, we must be sure that woodland development will not result in the local loss of predators--either animals or birds--and the resulting population explosion of animals or insects that may, in large number, prove to be serious pests.

The diverstiy of woodland flora and fauna is aided by the different patterns and rates of succession dependent upon natural disturbance. Adjoining forest and meadow communities create ecologically crucial edges, those spots at which most animals feed. Here deciduous forest birds may intermingle with open field species, both sharing the resources between the two communities. Between the meadow and forest there are many mammals, such as cottontail and deer, who feed in the meadow and seek shelter in the forest.

The variety in natural environments is crucial to their health. The more options an ecosystem has for the breeding, feeding, and shelter of its fauna and flora, the more likely it will be to absorb the effects of any disturbance. Once this diversity is lost, however, as it is in a tree farm of uniformly aged and sized trees, the more susceptible the area is to the effects of disease, fire, and other distrubances. With few niches for animal and insect life, the essential role of pest predation is lost and must be replaced by the even less experienced hand of man in the use of pesticides.

Since the more diverse choices open to an ecosystem in times of stress, the more able it is to absorb disturbance without serious damage, it is certainly within the public interest to protect the diversity of the woodland ecosystem. This goal is particularly important in the suburban forest, where human activities disturb the natural ecosystem to one degree or another. If the forest is able to adapt to human influence, it will continue to provide benefits to the public. Careful regulation of woodland land use will protect the diverse character of the forest ecology and keep its ecosystem healthy and resilient.[6]

2. Woodlands Give Protection to Watersheds and Soils

A wooded area can be of great value to a watershed area. The canopy of trees and understory aid in breaking the force of precipitation, thereby decreasing erosion. Erosion is further inhibited by the fibrous root system of the understory plants, as well as by the layer of leaf or needle litter. As the force of precipitation is decreased by the vegetation and the absorptive qualities of the usually porous forest floor, more water is given additional time to soak into the ground. Thus, forests aid in reducing not only the force of precipitation, but the amount of runoff as well.

Woodlands also afford protection from wind erosion. Just as the vegetation breaks the force of precipitation, leaves and branches moderate the strength of winds. Not only is the ground beneath the forest protected, but wind velocity on the leeward side of the forest is reduced by up to 60 per cent.

Though forests tend to moderate flooding and erosion, they do not necessarily prevent them. Floods may still occur from forested regions, but the destruction of a woodland will increase the rate of flooding. It has been shown that little, if any, runoff comes from heavily forested lands, except during periods of heavy precipitation. However, clearcut lands can produce excessive runoff more significantly unless the trees are replaced by other vegetation with comparable water-retaining capacity. Thus, forests are important flood moderators in those areas where flooding is the result of runoff or rapid snow melt. The shade effect of the evergreen forest, and to a lesser extent of the deciduous one, allows snow to melt over a lengthy period of time, again serving to moderate effects of flooding from meltwater.

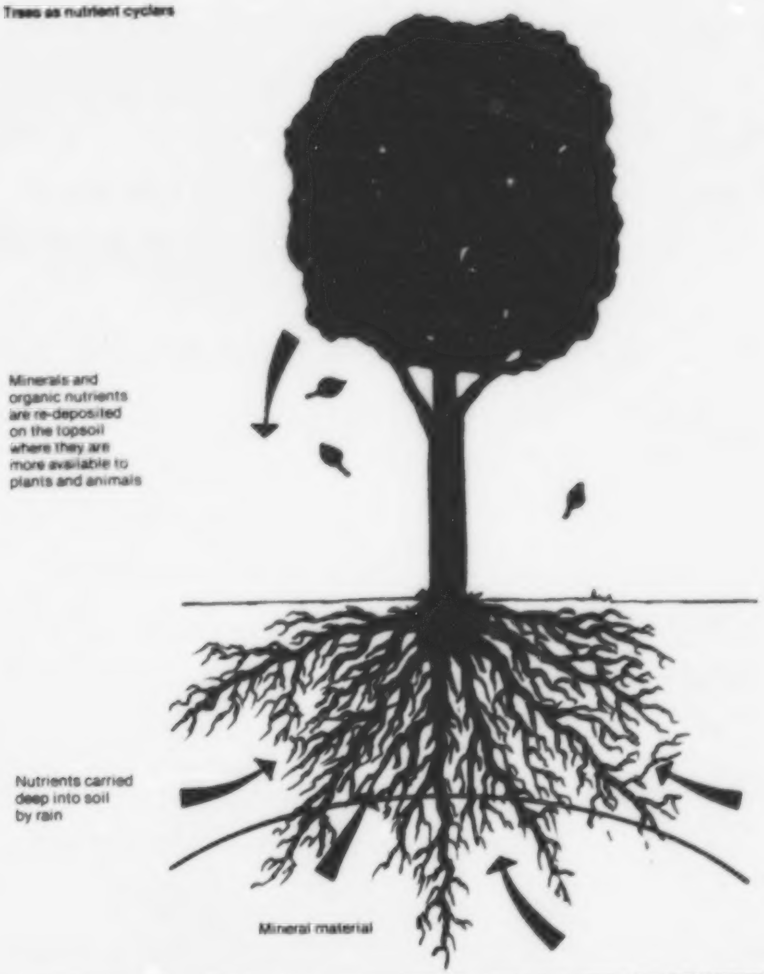
Woodlands are not, however, completely satisfactory cover for a watershed upon which people depend for water. Although they increase the ability of the soil to absorb water by decreasing runoff rates, trees themselves are heavy consumers of water. Almost 99 per cent of water absorbed through tree roots is transpired, or evaporated, into the air. Studies show that clear-cutting of a forest will increase the water yield in both runoff to streams and percolation into groundwater resources by rates ranging from 20 to 60 per cent. It has been suggested that selective clear cutting in stands of timber above watersheds could be an effective way of increasing water yields.[7]

While clearcutting has been used in some water management programs, irresponsible use of clearcutting results in serious damage to the watershed. The damage occurs through increases in siltation and runoff and through depriving groundwater of an important filtering system. The forest floor, with its deep layer of organic litter and decomposing bacteria and insects, acts as a filter to the water which falls on the forest. The ability of the forest floor to absorb and dispose of impurities has led some experts to suggest use of the forest as a living filter for disposal of municipal wastes. Application of sewage to forests in Los Angeles at the Whittier Narrows allows for disposal of 10 to 15 million gallons of municipal sewage water per day. The water is recovered, purified, and mixed with Colorado River water and recharged into the area's groundwater supplies.[8] The forest floor is also an important builder of soils, as well as filter of water. The deep and extensive root systems of most tree species serve as recycling pumps for deeply stored minerals and nutrients. During the growing season, minerals, water and organic nutrients are brought into the leaves. When deciduous trees, especially maples, drop their leaves in the fall, they decompose and provide food for plants and animals. As this process continues, plants increase their productivity, the organic soil can be gradually restored to health. (See Figure VII-4.)

Woodlands are particularly important protectors and conservers of watersheds and soils in certain critical areas. Destruction of woodlands in hilly or mountainous regions can have serious effects. In such areas, where the soil mantle is especially thin, the loss of forest cover can result in erosion of the valuable soil. With no soil and vegetation to moderate runoff from precipitation, flooding may result, as well as loss of precipitation ordinarily retained and recharged into groundwater reserves by the forest. The soils of the mountainous regions in the east and west, as well as those in the north-central and northeastern states where a thin soil mantle overlies bedrock, are particularly vulnerable to the loss of vegetative cover.

In other areas of the country, especially in some southern states, forests help to improve the quality by providing organic litter which keeps the sandy or clayey soil friable as well as fertile. Loss of woodlands in these areas often results in an uncultivable, baked clay surface of land.

Figure VII-4


Trees as nutrient cyclers

Minerals and organic nutrients are re-deposited on the topsoil where they are more available to plants and animals
Nutrients carried deep into soil by rain
Mineral material

3. Woodlands Are Buffers to Pollution

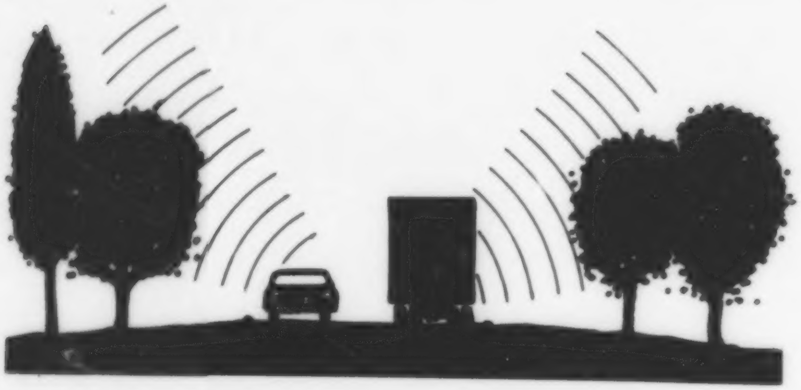
Not only do the forests aid in soil and water quality, they also aid in air quality. Leaves moist with dew or rainwater can reduce the suspended particles in the air, which are later washed off by rainwater. But plants can also serve to moderate the effect of chemical pollutants in the air by absorbing some quantities of ozone, carbon dioxide, and sulfur dioxide. Though plants can absorb such pollutants and thus moderate their effect, trees themselves can be severely damaged by them, as some trees along the freeways in Los Angeles have been by the vast quantities of ozone produced from automobile exhaust. Conifers and other evergreens are particularly susceptible to air pollution since, unlike deciduous trees, they retain their needles year-round. This is a particular problem in cold climates where salt used on highways and streets severely damages evergreen trees.

Forests can also contribute to the abatement of noise pollution. The density of a forest as well as the source of the sound are the critical factors here. A dense stand of trees can significantly cut noise from adjacent factories or highways by six to eight decibels per 100 feet of forest. Many conifers, because of their thick, year-round foliage, are particularly valuable for moderating noise. (See Figure VII-5.) Moreover, the moderating effects of forests on temperature and wind can significantly cut the sound-carrying capacity of the atmosphere. However, noise from sources located above the trees, such as airplanes, are only slightly filtered by the foliage.[9]

The significance of woodlands is given added weight by the less quantifiable benefits they provide to the public. Forests are important buffers in the landscape. They add aesthetic values to rural, suburban or urban life as well as provide attractive sites for recreational activities, such as hik-

Figure VII-5

Noise and exhaust buffering by trees



ing, camping, picnicking and other types of recreational activity. Scenic and recreational uses of the forest provide a secondary benefit: the continued stability of good real estate values. Since people choose to live in and around woodlands, providing for woodland protection in the planning of development projects will maintain good real estate values.

4. Woodlands Are Moderators of Climate

The resilience of forests in adapting to environmental change is aided by the creation of a microclimate around the forest itself. The forest not only adapts to its environment, but also significantly influences it on a local level in order to maintain and augment environmental conditions favorable to itself. Those qualities of the forest in moderating and

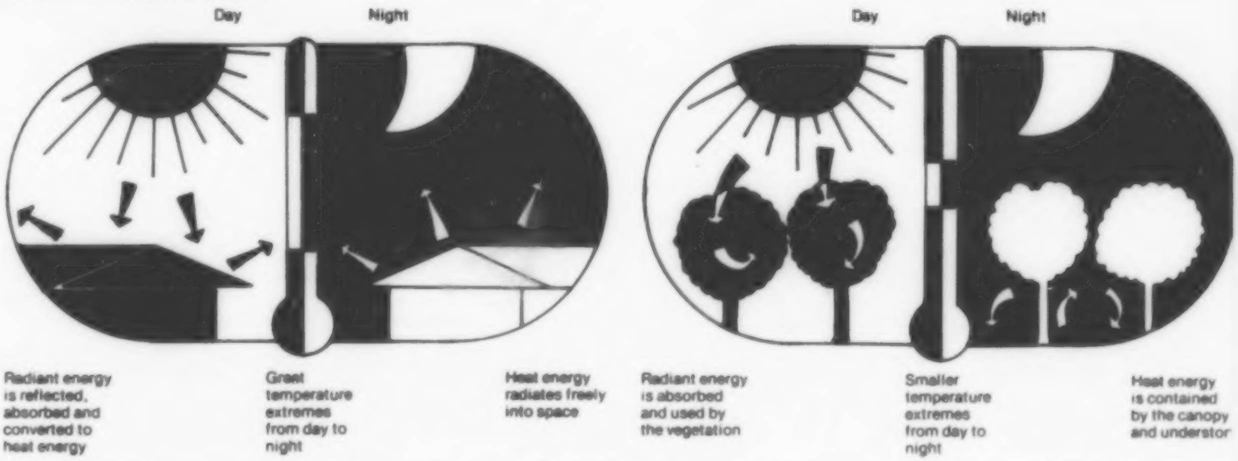
and buffering temperature, precipitation, runoff, wind, and noise are features of this microclimate effect.

The most marked manifestation of the microclimate of a forest can be noticed as one drives past a woodland on a hot summer day. The wind from the fields and towns is hot, while the forest provides a cooling breeze. The forest canopy functions much like a cloud cover, keeping warmth from the ground in at night and dispelling heat from the sun during the day. Part of the dispersal of daytime heat is accomplished by absorption of solar radiation. Sixty to 80 per cent of solar heat intercepted by the forest is used in evaporation, and the process of photosynthesis transforms an additional, though smaller percentage of it. (See Figure VII-6.) Moreover, the vegetation of the forest produces "summer haze," a cover of water vapor from transpiration and evaporation which can absorb up to 20 per cent of incoming solar radiation. The forest thus acts as an air conditioner to surrounding areas by absorbing large quantities of radiation and moderating large amounts of air within its shade.

The benefits of this microclimate effect to surrounding urban and suburban areas can be significant. An urban environment devoid of vegetation is the exact opposite of the forest microclimate. It increases the range of temperature fluctuations, much like the climatic effects of the desert. The sun's energy striking streets and buildings is changed into sensible heat, further increasing the temperature on a hot day, but at night buildings lose this heat and afford no protective cover from night chill or winter winds. Thus, if forests are interspersed among built-up areas, the effects of their

Figure VII-6

The microclimate effect of woodland


Day
Night
Day
Night
Radiant energy is reflected, absorbed and converted to heat energy
Great temperature extremes from day to night
Heat energy radiates freely into space
Radiant energy is absorbed and used by the vegetation
Smaller temperature extremes from day to night
Heat energy is contained by the canopy and understor

microclimates can be felt in adjacent urban areas, moderating fluctuations in temperatures by keeping the surrounding air cooler in the summer and daytime and warmer in the winter and evening.[10]

C. The Local Regulation of Woodlands

Without some form of land-use regulation in wood areas, a community risks the loss of its forest and tree resources and their many public benefits. A community may also find its tax dollars being used to repair the damage to other resources as a result of the unregulated development of woodlands. In such cases, communities must absorb the substantial economic costs of woodland destruction, such as increased sedimentation, loss of soils as a result of erosion, decline in water quality, damage to recreational areas, and lowered property values. The idea of land-use regulation in wooded areas is to prevent these losses and expenses by identifying the specific benefits woodlands provide to the community and implementing measures to assure that woodland development is compatible with the health of forest resources.

While regulations have been developed to protect other critical environmental areas, woodlands have been relatively ignored, even though their benefits to the public as buffers and moderators of flooding, erosion, and noise and air pollution are so important to the public good. While hillside ordinances and erosion and sedimentation regulations play a part in protecting woodland resources, there are few provisions specifically directed at maintaining the health of forests. Trees within the public domain, such as those growing on city streets or in parks and forest preserves, are as a matter of course given protection. This study is more concerned with those regulations which have been developed to protect the public values of woodlands found on private lands. Some of these lands are large enough to support some commercial forestry, others are limited stands of trees threatened by commercial, agricultural,or residential development.

The three types of ordinances providing protection for the public resource values of woodlands are tree-preservation ordinances, timber-harvesting ordinances, and woodland-protection ordinances. A tree-protection ordinance is concerned with preserving as many yard and street trees as possible as land is developed for residential or commercial use. This policy is implemented by setting standards for tree preservation and requiring permits for cutting mature trees. These ordinances can operate citywide or in a specific tree preservation zone--usually single-family residential areas. Timber-harvesting ordinances are concerned with regulating commercial forestry practices specifically within urbanizing areas. They limit the lumbering companies to selective cutting and regulate potential nuisance-like uses of the land,such as noise, log hauling, increased erosion and mudding of surface water. And finally, the woodland-protection ordinances identify sensitive wooded areas and propose to preserve not simply trees, but the entire woodland ecology. Both tree-preservation and timber-harvesting ordinances have been adopted by communities; woodland-protection ordinances have not.

1. Purpose and Policy

In terms of purpose and intent these ordinances are all similar. The model woodland ordinance designed by Michigan's Oakland County Planning Commission is typical of them. It finds that rapid growth, the spread of development, and increasing demands upon natural resources have had the effect of encroaching upon, despoiling,or eliminating many of the trees and other forms of vegetation and have disturbed the natural processes associated with them. It also identifies the specific health,safety,and welfare functions of these areas: (a) woodland growth protects public health through the absorption of air pollutants and contamination, through the reduction of excessive noise and mental and physical damage related to noise pollution,and through its cooling effects in the summer months; (b) woodlands provide for public safety through the prevention of erosion, siltation, and flooding; and (c) trees and woodland growth are an essential component of the general welfare by maintaining play areas for children and natural beauty, recreation, and an unreplaceable heritage for existing and future residents. Consequently, the purpose of the ordinances is to provide for the protection, preservation, proper maintenance and use of trees and woodlands in order to minimize disturbance to prevent damage from erosion and siltation, a loss of wildlife and vegetation, and/or from the destruction of the natural habitat. (For the complete text see the appendices to this section.)

The central issue that all the ordinances address is the conflict between urban development and the maintenance of these natural resources. All of them have the same comprehensive concerns of the Oakland Ordinance, and some of them go on to cite specific dangers to the community that the ordinance attempts to alleviate. Saratoga, California's tree-preservation ordinance, for example, mentions its air pollution problems with carbon dioxide from neighboring industrial areas and freeways as a specific reason for enacting protective legislation. The tree-harvesting ordinances also extend their scope by addressing hazards specifically related to harvesting techniques such as water quality control, sustained yield practices, fire prevention and control, and traffic safety.

Likewise, the ordinances may also cover benefits or dangers peculiar to the local community. A number of communities in the South and West have designated heritage trees--trees that because of their individual history or because of their species are particularly important to local identity.

The redwoods in California and the live oaks of the South are often given special protection. Likewise there may be provisions preventing the planting of nuisance trees that have shallow roots and fall easily or present other dangers.

Although these three kinds of ordinances look alike in their purpose statements, they must be treated separately because they are approaching the protection of public resource values in substantially different ways.

2. Tree Preservation Ordinances

At the present moment, tree-preservation ordinances have more general acceptance than the others. In 1968 when Charlotte Bingham wrote her report on Trees in the City, she found only six cities which had enacted tree preservation legislation.[11] However, according to a more recent study by the International City Management Association, 31 per cent of the cities and 10 per cent of the counties surveyed had some form of tree-preservation ordinance.[12] It is unclear exactly what local communities consider tree preservation ordinances, and they may be including open space, wetland, or erosion-control ordinances which have tree preservation elements in them. But it is clear that the number of communities attempting to preserve these natural resources by tree-preservation ordinances is growing.

Atlanta, Georgia's tree preservation ordinance, described in some detail in the Bingham report, remains one of the most comprehensive. It defines a tree-protective zone and creates the position of city arborist to administer the regulations. A tree is defined as "any woody plant except dogwood that has a single trunk with a caliper of five inches or more at six inches above the ground." (A dogwood, the official tree of Atlanta, becomes subject to regulation when the caliper reaches two inches.) The standard of five inches in diameter is generally accepted by botanists as the distinction between mature trees and saplings. The specific size of tree protected, however, would be a function of the tree species and the growing considerations in the local area. For example, Atlanta sets a different standard for dogwood because it is a smaller species. A two inch dogwood is a mature specimen while a two inch elm or oak would still be considered a sapling. On the other hand, in a more arid climate than Atlanta's--characterized by very slow tree growth, the standard would also be different since a two or three inch tree could represent a more significant resource in terms of the time it would take to replace it.

The Atlanta Tree Protective Zone itself is the portion of the lot covered by the front, side and rear yard requirements established by the Zoning Ordinance. And the ordinance protects the trees before, during, and after development. In order to protect undeveloped land, the ordinance specifies that on land where a building permit or subdivision approval has not been issued, "the destruction, within any five-year period, of more than 25 per cent of the trees on any one parcel of real property within the City, without prior approval of the City Arborist, shall be prohibited."

Before development can occur, the developer must submit a site plan to the City Arborist which includes the following information:

A. All existing trees within the Tree Protective Zone which are at least 5-inch caliper at 6 inches above the ground and all Dogwood trees which are at least 2-inch caliper at 6 inches above the ground.

B. Trees to be removed and trees to be maintained.

C. Specifications for the removal of existing trees and protection of existing trees during construction.

D. Grade changes or other work adjacent to tree which would affect it adversely, with specifications on how the grade, drainage, and aeration will be maintained around the tree.

The City Arborist then reviews the site plans to be sure that "trees are retained in lawn or paved areas within the Tree Protective Zone without making demands on the owner which would deny him the reasonable use of his land." If the plans are denied "the reasons shall be reported, in writing, to the applicant."

During development the ordinance requires that "the builder shall erect suitable protective barriers around all trees specified to be maintained and shall not allow storage of equipment, materials, debris or fill to be placed in this area except as may be necessary for a reasonable time if no other storage space is available."

The ordinance also includes sections dealing with permits for tree cutting, pruning, and removing at other times. It provides for emergency removal in situations such as windstorms or ice storms so that permits for tree removal can be waived in order to speed emergency work. Also individual homeowners in areas zoned for single- or two-family occupancy are exempt from permit requirements except where more than two neighboring lots are being developed at one time.

There is a question whether the exemption of individual homeowners from the ordinance is effective. After preserving the trees before, during and after development, the homeowner can go ahead and remove them. This is certainly a possibility. However, the ordinance does bring the most gross and outrageous abuse of tree resources under control. It assures the community that developers will not clear cut any area simply because it allows cheaper development. In this implementation of the goals of preserving the beneficial effects of trees by maximizing the retention of trees already on the site, the Atlanta ordinance is well designed.

While these ordinances were originally designed to preserve shade trees in residential environments, they have been significantly broadened and refined. One of the most interesting of these is Leon County, Florida. They have developed two zones for tree protection. The first of these, the Primary Tree Protection Zone, is essentially the same as Atlanta's. The zone covers the front, side, and rear yard setback areas as established by the zoning codes of the City of Tallahassee and Leon County. In this zone any tree at least four inches in diameter measured at a height of four and a half feet is a protected tree and needs a permit from the Environmental Administrator for its removal. The second of these zones is new. The Secondary Tree Protection Zone is not limited to the yard areas but includes all land in single-family or two-family residential districts, mobile home districts, estate districts, and agricultural districts. In this zone "any tree having a diameter of 36 inches or greater is a protected tree." This zone is designed to protect the live oaks and other large trees that have taken hundreds of years to grow in the area and give the community much of its character. For these large trees, the community becomes involved whether or not they fall within the established setback areas, and it attempts to preserve them wherever they occur.

Leon County has also recognized that it is more important to preserve established native trees than simply requiring tree plantings. Consequently, they have coordinated their landscape ordinance with their tree-preservation ordinance. In order to maintain the resource values of trees to the community, the landscape ordinance establishes a public policy "to foster a county-wide reforestation program." The reforestation program requires that any developed area shall have trees at "the ratio of 10 trees for each acre and 5 trees for every major fraction thereof." This section of the landscape ordinance addresses the general need for landscaping and guarantees that such areas as shopping center parking lots will have some trees. It encourages tree preservation since if the trees are not preserved they will have to be replanted. The developer can cut his costs by simply designing his site to preserve trees already present rather than going to the expense of planting new trees. It also reduces the problem of trees mysteriously dying or disappearing. If they do, they will have to be replaced.

The Leon County Landscape Ordinance gives further incentives for tree preservation by providing an exchange rate between established trees and the required 10 trees per acre:

7.1 Exchange Rate--The reforestation requirement shall be credited for preserved trees at the following rate:*

Existing Crown Spread of Preserved Tree	OR	Diameter** of Tree Trunk of Preserved Tree	=	Number of Trees Credited
90 ft. or greater		36 ins. or greater		7
60-59 ft.		30-35 ins.		6
50-59 ft.		26-29 ins.		5
40-49 ft.		20-25 ins.		4
30-39 ft.		13-19 ins.		3
20-29 ft.		8-12 ins.		2
16-19 ft.		4-7 ins.		1

---

*Crown spread measurement shall be rounded off to the nearest whole foot and the tree trunk diameter measurement shall be rounded off to the nearest whole inch.

**Measured at a height of 4-1/2 feet above the natural grade.

In order to obtain credit the preserved trees must be of a specific quality. (The ordinance stipulates that they be of quality grade Florida No. 2 or better, as described in Grades and Standards for Nursery Plants, published by the Florida Department of Agriculture.) The continued health of these trees is also protected by a special requirement that 50 per cent of the ground area under and within the drip line of the trees be maintained in vegetative landscape material or pervious surface cover.

In essence the Leon County ordinance is a credit system that establishes the relative value of existing trees and newly planted trees: an oak with a 14-inch diameter and crown spread of 38 feet is equivalent to three new saplings planted on the site. In contrast to this, Gainesville, Florida, has developed a system which exchanges general landscape requirements for tree planting or preservation. Their landscape ordinance requires that a minimum of 10 per cent of the total developed area of any parcel or property which comes within the provisions of the ordinance be devoted to landscape development. The planting or retention of trees acts as a credit for this requirement. In the case of planting trees, large-tree species (which are listed in the ordinance) give 230 square feet of credit and medium-sized tree species (also listed) give 100 square feet. In the case of preserving mature specimens the credit is higher:

Large Trees: greater than 12-inch caliber--500 square feet
greater than 6-inch caliber--400 square feet

Medium Trees: between three to 6-inch caliber--200 square feet.

Like the Leon County ordinance, this ordinance also has provisions for preserving an area around the tree to provide water and nutrients to the tree. If a developer has an oak of 13 inches on his property which he preserves and preserves a 1,000 square feet around it, it would count as 1,500 square feet on his 10 per cent landscaping requirement.

Dovetailing the tree preservation ordinance with the landscape ordinance provides a more equitable land control system. Those landowners who have trees on their property are not treated differently than other landowners. All are required to provide vegetative cover on part of their property, but those with substantial trees are given the option of preserving those trees instead of following the general landscape requirements.

The communities that have implemented these tree-preservation ordinances have found them effective. They have not run into serious legal difficulties,and the permit systems have been easy to administer. In turn, they have substantially decreased indiscriminate tree cutting. Their effect for a community, however, is very much like a street tree ordinance or a landscape ordinance that requires trees to be planted along residential streets or within commercial development. They have the distinct advantage of maintaining already mature trees, and maintaining mature trees which are likely to be native species so that there is some assurance that the trees are adapted to the climate and soil conditions of the area. This approach also avoids the problems of a single stock of trees which have occured with the American Elm plantings in many midwestern towns.

These ordinances do not, however, protect woodland ecology. Though they preserve some of the trees themselves, they do not protect the understory of shrubs and herbs, nor the leaf and litter layer of the forest floor. With these gone, much of the effectiveness of the forest to moderate runoff is gone, and much of its ability to absorb the impacts of suburban or urban stress are gone.

There have been some attempts to redesign so that they are more sensitive to the ecological functions of wooded areas. One way is to connect the permit system more closely to these functions. Hayward, California has been particularly successful, using a criteria list for both removal or retention of trees. Instead of requiring a set number of trees per acre, the requirements are in terms of how the trees function:

> (b) The determination of the Parks Superintendent or his designated representative shall be based on the following criteria:
>
> (1) The condition of the trees with respect to disease, danger of falling, proximity to existing or pro-

posed structures, interference with utility services and interference with neighboring property owner's views.

(2) Necessity to remove trees in order to construct proposed improvements to allow enjoyment of substantial property rights.

(3) Topography of the land and the effect of tree removal on erosion, soil retention and the diversion or increased flow of surface waters.

(4) The number of trees existing in the neighborhood, and the effect of tree removal upon property values in the area.

(5) Good forestry practices: i.e., the number of healthy trees that a given parcel will support.

(6) The tree in question is of landmark importance and its retention as such will not unreasonably interfere with the use of the property upon which it is located.

A criteria list such as this ties the regulation more directly to the ecological functions of woodlands. In this case the preservation or retention would not be on tree size alone and whether it was within the yard requirements, but how important it is to the land. In administering the criteria on topography and surface water, for example, it may be better to maintain the trees on the steep section of the lot or along the natural drainage pattern than simply to save the largest trees. This criteria list could be expanded to fit the particular needs of the community so that it also includes the noise buffer function or other functions that Hayward has not used in its criteria list.

Another adaptation of the tree-preservation ordinance has been its use to protect the ecological function of specific kinds of tree communities.

A case in point would be a tree community important for reducing natural hazards. Clearwater, Florida,has pioneered in this style of tree preservation ordinance. In addition to their regular tree-preservation ordinance they have established two others: one to preserve a particular ecological benefit and another to prevent an ecological problem. In the first they have provided special protection for all species of mangrove. These trees line much of the coastal area and because of their root and stem structures they are crucial for absorbing the impact of storms and thus protecting the inland from high waves. In order to preserve this important safety function, no mangrove tree, regardless of size, located within an area thirty feet landward and thirty feet seaward of the established bulkhead line can be removed without a tree removal permit.

This adaptation of the tree preservation ordinance could be used in comparable situations. For example, in some of the dune areas of Long Island, New Jersey, or Michigan, the pine barrens prevent the dunes from being shifted by the wind. It would be appropriate to use a tree preservation ordinance in these ares in order to prevent the destruction of other land by shifting sand. In this case a permit procedure would both require a maximum retention of the trees and also evidence of how the disturbed areas would be stabilized. Another example, would be the gullies and draws in the West that are subject to severe flash flooding. Here the cottonwoods and other trees are an important break to the impact of the water.

Clearwater, Florida,has also protected itself against trees that can cause hazards themselves. They have forbidden the planting of punk trees and Brazilian pepper trees because they are an exotic weed species. They are a hazard to native vegetation because they can crowd it out and destroy the natural diversity in vegetation. In turn this causes monotypical stands that when struck by disease (or in this case frost) leave the community with serious hazard problems from fire or erosion.

3. Timber Harvesting Ordinances

Timber harvesting ordinances address a different set of issues than the tree preservation ordinance. They are designed for areas with commercial timber operations that are also experiencing urban and suburban growth. As such they are first interested in regulating harvesting practices that can either cause nuisance or hazards in this setting, second, they regulate timber harvesting in order to integrate the commercial value of the forest with the residential values of the woods, and finally, they regulate harvesting in order to sustain it as part of the economic base of the area. Though not every community has woodlands large enough to make commercial timber operations economically feasible, many of the provisions of these ordinances have application in other situations.

Much of the regulation of nuisance values is peculiar to timber harvesting. For example, the two counties that have used these ordinances--Napa County and San Mateo County, California--have provisions on noise control, log hauling on public roads, and fire hazards. (For the text of the San Mateo ordinance see the appendix to this section.) The planning commission is given the authority to regulate these activities. It can regulate the days and hours of timber harvest, when, in its opinion, such operations will create a serious public nuisance to resident population through noise pollution. Log hauling is not permitted on nonworking days such as Saturday, Sundays and major holidays or during peak commuter traffic hours. And, wherever practicable the companies must provide firebreaks to reduce fire hazards,and any open burning must be done only with the approval of the Air Pollution Control District. All of these controls are comparable to the local requirements that would be placed on other industries.

The more interesting provisions of these two ordinances is the methods they use to integrate timber harvesting with the general public resource values of the wooded areas. Specifically, they are interested in preserving soil stability--preventing erosion or landslides, and preserving surface water quality. This is done by a series of cutting specifications which require the company to use selective cutting procedures. In old growth stands--stands with trees greater than 200 years old--40 per cent of the live coniferous trees 18 inches in diameter or greater must be left. Within this 40 per cent, 25 per cent of the trees between 30 and 60 inches in diameter must be left and 15 per cent of the trees over 60 inches must be left. In these stands the timber operator is also encouraged to leave coniferous trees over 30 inches in diameter in such locations and in such manner as to minimize the risk of windthrow and maximize streamside, scenic,and recreational values. There is a similar set of requirements for prior cut stands, but here the timber operator is allowed to thin dense thickets to allow for better timber production. Finally, there are more restrictive cutting specications within roadside corridors and scenic corridors.

Often the loss of trees causes less damage to the forest ecology than the process of getting heavy equipment into the forest, cutting the trees, and taking the logs out. Consequently, the San Mateo ordinance has extensive specifications for construction activities associated with timber harvesting. The truck roads, tractor trails, firebreaks and landings are to be located and designed so that they do not: 1) adversely affect the stability of property owned by others; 2) cause soil to be deposited on property owned by others; 3) cause excessive erosion and landsliding; 4) contribute significantly to the degradation of water quality. The specifications for these activities are designed to minimize their impact. The road widths are limited to single lane, they are to be laid out to follow the contour of the land. The tractor trails are not to be constructed parallel to natural watercourses where such construction will likely cause major soil movement, and landings are to be constructed are in open areas whenever practical.

The most detailed of the specifications relate to maintaining natural drainage patterns and protecting streams. In all the construction the waterbreaks are to be designed to keep the surface runoff following its natural pattern rather than becoming channelized along the road or trail construction. Likewise all streams must be protected with buffer strips or with additional soil erosion control provisions to maintain their water quality.

The third objective of these ordinances is to maintain the forest as an economic resource for the area. This is primarily done by the selective cutting requirements described earlier. These cutting requirements also specify the leaving of seed trees to allow reforestation of the area. In addition, the San Mateo ordinance also limits the frequency of timber harvesting. For both conifer and hardwood stands harvesting is limited to only one operation in any 10-year period of time. And even then this is dependent on whether minimum stocking has been accomplished in that period. This minimum is established in the definition section of the ordinance as a count of 600 per acre where trees of three years of age and less than four inches in diameter count as one, those between 4 and 12 inches count as three, and those over 12 count as six.

While these regulations appear to be fairly restrictive toward the lumber operators, they can be an advantage to them. Once a productive timber area starts becoming urbanized, these companies come under pressure from the new inhabitants. The residential homeowners do not like the noise, the traffic, the way the landscape is changed by timber practices--timber practices that may be perfectly acceptable in more rural areas. By ameliorating these kinds of conflicts, the local government actually helps maintain the viability of these operations, and the consequences of one poorly designed timber operation will not jeopardize the rest.

Both the San Mateo and the Napa County ordinances are highly technical ordinances. The level of detail concerning harvesting specification requires complex application and review procedures. The timber harvester must provide detailed information about his procedures for a given site, including topographic maps indicating ownership of surrounding land and the location of all construction,such as roads, trails, and drainage structures. In turn the planning commission must evaluate the application, do a field investigation, and hold public hearings with prior notices going to all property owners within 2,500 feet of the parcel to be harvested and to domestic water suppliers whose watershed includes all or part of the parcel to be harvested. For the ordinances to be effective they require the planning commission to have forestry expertise on their staff in order to assure quality work on this review, and to assure that the necessary monitoring is done during the actual harvesting process. To remain effective, the ordinances themselves must be kept up-to-date with the "best known" forestry practices.

4. Woodland-Protection Ordinance

The Model Woodland Protection Ordinance, as established by Oakland County, Michigan, seeks to protect the entire woodland--not only the trees but the associated flora and fauna as well. In its comprehensive approach it is more similar to ordinances for other sensitive areas such as floodplains and wetlands. The only acts that are permitted as a matter of right are the traditional list of "light uses":

(i) Conservation of soil, vegetation, water fish, and wildlife;

(ii) Outdoor recreation: including play and sporting areas, field trails for nature study, hiking and horseback riding, boating,trapping, hunting,and fishing where otherwise legally permitted and regulated;

(iii) Grazing, farming, gardening,and harvesting of crops, and forestry and nursery practices where otherwise legally permitted and regulated;

(iv) Operation and maintenance of existing dams and other water control devices, if in compliance with state statutes;

(v) Driveways and roads where alternative means of access are proven to be impractical.

Any other uses require a permit. The prohibition section of the ordinance is similar to the tree-preservation ordinances in that it prohibits the removal or damage of any trees with a trunk diameter of three inches and also prohibits the removal of trees and similar woody vegetation of a small diameter when they are growing on land subject to the town's or county's floodplain and wetland protection zones.

Unlike the floodplain and wetland ordinances, however, the woodland-protection zone is not designed as a limited-development area. Compatible development is allowed through a permit procedure which operates by a set of standards:

> Section 2. Standards.
>
> The Commission shall establish specific standards to guide the development of woodlands in this Township, including the spacing of trees, the clearing of shrubs and brush, the density of vegetation growth and preservation per acre, forestry and tree replacement practices. However, since the environmental values, soil characteristics, tree growth, and related natural resource parameters will remain unique for each parcel of land and for each development application--each permit application shall be reviewed on an individual basis. Nonetheless, the following criteria must be considered and balanced with respect to each permit application under this Ordinance:
>
> (1) Residential living units shall blend into the natural setting of the landscape for the enhancement of sound, orderly economic growth and development and for the protection of property values in this Township.
>
> (2) The preservation of woodlands, trees, similar wood vegetation, and related natural resources and values, as more fully described in article two (2), shall take priority over all forms of development--particularly industrial and commercial development--when there are no location alternatives.

(3) The protection and conservation of irreplaceable natural resources from pollution, impairment, or destruction shall remain the paramount factor.

(4) No application shall be denied solely on the basis that some trees are growing on the private or public property under consideration. Other factors which demonstrates a public need for woodland preservation must be stated.

(5) The total acreage of woodlands per capita existing in the Township shall be considered.

(6) Each application shall be reviewed to measure the likelihood that some of the parcels of land in question may be required for recreation and/or other public acquisition purposes in the near future.

(7) The relationship of streets, highways, and other transportation corridors to the woodland area shall be considered, along with alternatives for new transportation routes and for the location of the proposed development.

(8) All recommendations by the Commission under this Ordinance shall be consistent with total, comprehensive community planning for this Township.

(9) The burden of demonstrating (i) that there are no feasible and prudent alternatives to the development proposed in a permit application under this ordinance and (ii) that denial of any requested permit will prevent an owner of property in this Township from securing a reasonable or fair economic return from his property--shall be on the applicant.

The attractive part of this ordinance is that it brings some of the advantages of planned unit development ordinances to development in wooded areas. The Lake Tahoe PUD ordinance, for example, states:

> All subdivisions shall be planned, designed, constructed, and maintained so that existing healthy trees and native vegetation on the site are preserved to the maximum extent feasible and are protected by adequate means during construction.

The woodland ordinance attempts to implement this goal. While the PUD procedures have the advantage of working with larger developments and can thus obtain tradeoffs of clustering with open space preservation, the woodland ordinance, on a smaller scale, can do some of the same. By coordinating the placement of residential units, for example, the interior parts of a development could be left in a natural wooded condition. This feature of the ordinance could be especially beneficial when a community is concerned about areas with significant stands of climax, relic, or particularly ecologically valuable woodlands, or when the wooded areas are critical because of their location on fragile soils, or along ravines or hill ridges where the erosion-control function of the total forest ecology protects the land more completely than simply leaving a maximum number of trees.

a. Strengthening the Model Ordinance

(1) Regulation of permitted uses--There are weaknesses in the Oakland Model Ordinance itself. Some of these are similar to the problems of wetland ordinances. The traditional permitted "light uses" are not necessarily compatible with woodland ecology. For example, grazing or agriculture could seriously disturb these areas and eventually destroy them by cutting off the growth of saplings and thus preventing woodland reproduction, as well as destroying understory vegetation. In addition, it is doubtful that a court would accept these as adequate uses of the land,since it is difficult to pursue agriculture or livestock grazing on small parcels. This difficulty, however, may be less serious than with wetlands,since other forms of land use, such as residential development--are easily possible

under the conditions of the ordinance. However, to assure that permitted uses such as roadways and forestry practices are pursued in a manner compatible with woodland ecology, supplemental regulations, such as those developed for timber harvesting, would be useful.

(2) Environmental information--Another change that could strengthen the model ordinance would be the inclusion of more specific requirements concerning information to be provided by a potential developer. (Again, see following section on Timber Harvesting Regulation.) In some PUD ordinances, such as that of Boulder, Colorado, detailed information is required about the location, species, and quality of the trees present before development. Similar kinds of information requirements for woodland-protection ordinances would ensure a better job on permit decisions. An application for permission to develop under a woodland-protection ordinance should contain, in addition to the usual site plan, two kinds of environmental information--baseline information and impact information.

Baseline information concerns the existing state of the wooded area, provides the essential framework within which the developer's application can be evaluated, and is particularly important for the application of any cutting provisions of the ordinance. At a minimum, this information should deal with existing drainage patterns, slope conditions (by average slope in gradations of 10 per cent), soil conditions, and trees. The tree information should cover the types of trees; their size (d.b.h.) by type, their age by type, their conditions by type, and their density and spacing. If the community does not have this information in a natural resources inventory of its own, then the developer should be required to submit this information as part of the initial application.

Impact information concerns the state of the wooded area after the completion of the development. This information would cover exactly the same items of information as the baseline information. Together, the baseline information and the impact information would provide before and after pictures of how the proposed development would affect the woodlands. Moreover, the conjunction of the two kinds of information would allow the identification of the trees that are to be removed.

(3) Policies and standards--Under the technique of permit review, environmental information is particularly important. Placing the responsibility for setting specific standards for woodlands development on local planning commissions or planning staffs often overburdens the expertise of these bodies. They usually do not have available the knowledge that allows them to relate particular development proposals to specific principles for spacing trees, clearing shrubs and bushes, establishing densities for vegetation growth, replacing forests and trees, and similar undertakings. This inability on the part of local bodies usually results in their creating a series of generalized practices or policies that apply to all developments. Such general policies without effective evaluative measures are not a subsitute for specific standards or criteria.

These standards can be adapted from current tree-preservation ordinances and timber-harvesting ordinances. The Hayward, California criteria, that was described earlier, would fit well with a general woodland-protection ordinance. These criteria are designed in terms of ecological functions of woodlands and the decision to allow development depends upon the effects it will have on erosion, soil retention,and the diversion or increased flow of surface water. The timber-harvesting ordinances also have provisions for protection of water quality--forbidding any activity which causes significant degradation of water quality in streams that are important for domestic water supplies or act as important resources for fishing or other recreational activities.

If desired, communities could develop specifications for construction in these areas. These would adopt some of the construction specifications from the timber-harvesting ordinances so that they would apply to other kinds of construction. It would require roads to follow the contours of the land, that they could not parallel streams, that they would have drainage and erosion control facilities at set intervals. Likewise, as much as possible, other forms of construction would be placed in already open space areas and they would not be within a specified distance from any stream or natural drainage channel. The weakness of these specifications, however, is that they would lock the developer into one type of construction when he may be able to do a better job of designing the land development with greater flexibility. It would be better to set performance criteria for development that would meet resource consideration: for example, setting specific water-quality standards, requiring that surface runoff from a site must be maintained at a specific percentage of runoff with natural woody vegetation, or establishing standards for canopy and understory cover. This would allow the developer the latitude to both maximize his use of the land and still maintain the important public resource values of the woodlands.

b. Supplementary Provisions: Grading, Erosion, and Sedimentation Control

Aside from their standards concerning lot coverage and open or natural areas, woodlands regulations should also be closely tied to both a grading plan and a plan for the control of erosion or sedimentation. For any development in a wooded area, specific grading provisions and erosion/sedimentation provisions should apply. (See Section II for details on these requirements.) Whether these provisions are contained in the woodlands ordinance or in a related ordinance is not particularly important. What is important is that the provision be applied; after all in five minutes a bulldozer can destroy natural tree growth that took two hundred years or more. Furthermore, since wooded areas are especially important in the control of erosion and sedimentation, it would be unwise to assume that they will continue to exercise this function effectively in the face of nonregulated development. Some development may render them incapable of exercising these functions. The grading and erosion/sedimentation provision should be carefully calculated to maintain the environmental functions of a wooded area.

D. Developing a Local Program for Woodland Protection

The most crucial factor for developing protection measure for both trees and woodlands is clarifying the public values in these resources. It is one of the anomalies of our present regulatory system that most communities accept yard and landscape requirements, but feel reluctant about preserving their trees and forests. There is generally strong public support for maintaining wooded areas, but at the same time there is also a preconceived notion that it is not right for a community to require it of landowners. This reluctance is due to focusing too much on the aesthetic considerations--how nice it is to have woods around. They are nice, but they are also nice because they moderate temperatures, reduce noise levels, stabilize soils, maintain surface water quality, and help moderate storm hazards. All of these functions are important for preserving property values and protecting a community's welfare. Communities do not have to tolerate unreasonable abuses of these resources.

The first important step is analyzing a community's resources in terms of these specific functions, and then developing a style of regulation which is best going to protect them. If the prime importance is the maintenance of the microclimate effects of trees--their ability to cool the air, reduce winds, absorb pollutants and noise, then the tree preservation ordinance will provide the necessary protection. Most urban areas will probably find these techniques the most useful. If their importance derives from their ability to maintain soil stability and protect surface water quality, then the more comprehensive woodland regulation is appropriate. This regulation will maintain both the native canopy and the understory vegetation along stream banks, in natural drainage areas, and on steep slopes. If the woods are important for their commercial benefits to the community, then the timber-harvesting ordinance is best. The style of regulation needs to be adapted to the local community needs.

The reluctance to enact tree-preservation ordinances or woodland-protection ordinances has its greatest validity when it becomes an attempt to preserve one person's woods while allowing others to exploit similar resources. In some cases, communities may not want to preserve the general functions of woods in the area, but only preserve specific tracts of woods. For example, a community might want to preserve a unique tree community--such as a surviving stand of American chestnut or an important stand of redwood. While this kind of preservation has important public values in it, a regulatory program may be wrong because the weight of regulation falls on a few selected landowners rather on the general population. In these cases acquisition or some system of compensation is more appropriate.

Building equity into woodland protection so that all landowners similarly situated are treated the same is important and it is not always easy to do. Leon County, Florida, and Gainesville, Florida, have succeeded by developing a relationship between tree preservation and tree planting or landscaping requirements. All landowners have equivalent responsibility for maintaining vegetative cover. Techniques for building similar equity into a woodland-protection ordinance are not yet developed. It could be done by setting a specific percentage of land that had to remain in its native vegetation within the woodland district, and then build in flexibility by allowing density transfers to other lots when larger portions are preserved. Some system such as this would give each person equal use of his land, but also allow for the possibility of clustering development to exchange for larger units of intacted woodlands. However it is done, it is an important part of developing general community acceptance for woodland protection.

NOTES

1. Edward P. Cliff, "Trees and Forests in the Human Environment," Trees and Forests in an Urbanizing Environment, (Amherst: University of Mass., 1971), p. 18.

2. For a more detailed description of the regional woodland differences of the U.S. see the following:
   E.N. Transeau, H.C. Sampson, and L.H. Tiffany, Textbook of Botany (New York: Harper and Bros., 1953), p. 742;
   Forest Service, U.S. Department of Agriculture, Silvicultural Systems for the Major Forest Types of the United States, Agriculture Handbook No. 445 (Washington D.C.: U.S. Government Printing Office, 1973).

3. Transeau, et al., p. 743.

4. Eugene P. Odum, Fundamentals of Ecology,(Philadelphia: WB Saunders, 1971), p. 261

5. Robert L. Smith, Ecology and Field Biology, (New York: Harper and Row, 1966), p. 312.

6. The concepts of succession and diversity are discussed in detail in the following sources:
   Robert L. Smith, Ecology and Field Biology, (New York: Harper and Row, 1966), pp. 127-155;

7. Howard W. Lull, "Effects of Trees and Forests on Water Relations" Trees and Forests in an Urbanizing Environment, (Amherst: Univ. of Mass., 1971), p. 56.

8. William E. Sopper, "Effects of Trees and Forests in Neutralizing Waste," Trees and Forests in an Urbanizing Environment, (Amherst: University of Mass., 1971), p. 56.

9. Raymond E. Leonard, "Effects of Trees and Forests in Noise Abatement," Trees and Forests in an Urbanizing Environment, (Amherst: University of Mass., 1971), p. 38.

10. For an excellent discussion of the effects of woodlands and trees on the environment, (climate, noise pollution, erosions control, etc.) see:
    Gary O. Robinette, Plants People and Environmental Quality, (Washington, D.C.: U.S. Department of the Interior, 1972).

11. Charlotte Bingham, Trees in the City, (Chicago: American Society of Planning Officials, 1968), PAS Report No. 236.

12. Steve Carter, Lyle Sumek, and Murray Frost, "Local Environmental Management," The Municipal Year Book, 1974, (Washington, D.C.: International City Management Association, 1974), p. 258.

BIBLIOGRAPHY

Farb, Peter. The Forest. New York. 1963. (Time-Life Inc.)

> This is one of the Time-Life nature series with lots of color photography designed to have popular appeal. It is written from solid scientific information and represents an excellent introduction to forest ecosystems.

Forest Service, U.S. Department of Agriculture. Silvicultural Systems for the Major Forest Types of the United States. (Agricultural Handbood No.445) Washington, D.C. 1973.

> This pamphlet deals with timber management systems for the major forest types of the U.S. and has good information on regional aspects of forest lands. There are about 25 different types discussed; with a description of geographic region, dominant techniques. Particularly useful is a list of references following each section.

Smith, Robert L. Ecology and Field Biology. New York. 1966.

> An excellent basic ecology textbook with chapters on wetlands and woodlands. Chapter 9, Bogs, Swamps, and Marshes, and Chapter 11 on Estuaries, Tidal Marshes, and Swamps describe the ecosystems of freshwater and coastal wetlands. Chapter 17, The Forest, explains climatic differences within a forest as compared to open land and describes the major forest types of the earth. Not overly technical.

University of Massachusetts, Cooperative Extension Service. Trees and Forests in an Urbanizing Environment, proceedings of a symposium held at the University of Massachusetts, Amherst, August 18-21, 1970, Planning and Resource Development Series No. 17 (Amherst: University of Massachusetts, 1971), 168 pp.

> The 28 papers in this collection summarize current knowledge on the role and function of trees in contributing to a quality environment in densely populated areas. Deals with social values, management aspects, and ways to implement environmental forestry.

Waggoner, Paul E. and J.D. Ovington, eds. Proceedings of the Lockwood Conference on the Suburban Forest and Ecology. New Haven, Connecticut. 1962. (Connecticut Agricultural Experiment Station Bulletin 652.)

This work is a collection of papers that came out of the Lockwood Conference on suburban forests. It discusses the importance of forest lands to suburban and urban areas, the pressures that these lands face and how planning techniques can relieve some of this pressure. The edition contains pieces by some of the foremost people in the field of forest ecology.

DATA NEEDS AND TECHNICAL ASSISTANCE

The U.S.G.S. topographic maps indicate wooded areas. A green overprint on the maps gives a rough designation of areas of tree cover. The maps do not indicate type of dominant tree, density, or any other information about an area so they should be used only to get a general idea of where wooded areas may exist. Many libraries have the topo maps or they are available from the U.S.G.S. (See Appendix G, page 517.) Low altitude aerial photography has been done by some cities and counties; woodlands would be relatively easy to locate with this kind of data. If your community has had such photography undertaken, consult the photos for locating wooded areas. If these sources are not available a rough field survey of your area can identify wooded areas.

Once the boundaries of wooded areas are roughly identified you can begin with an inventory and evaluation of the vegetation of your woodland. What kind of trees are present? How old are they? Is this a mature, stable woodland? Are there any rare or endangered wildflower species? A professional forester or a naturalist with a knowledge of woodland vegetation can answer these questions. You could get the name of your state forester by calling the U.S. Forest Service regional office nearest you, (there are ten; see Appendix D, page 511). Ask for the regional forester, who will refer you to the state forester. The Forest Service is involved to some extent with all aspects of natural resources and should be able to answer most of inquiries relating to woodlands. The SCS and Cooperative Extension Service of the USDA also work with wooded areas and have naturalists who could make an inventory and evaluation of a woodland. Contact your state conservationist, (See

Appendix E, page 512), for SCS help or your county agent of the CES through the regular county offices.

The people from the Forest Service and USDA agencies probably have fairly broad backgrounds that include experience in wildlife, but if you have more complex questions about wildlife use of a woodland, or questions that the others cannot answer, the U.S. Fish and Wildlife Service specializes in just that. They will know about what endangered animal species might be using a woodland as habitat or feeding ground, or how disturbance will affect the wildlife of a wooded area. There are six regional offices plus an Alaska office of the USFWS. (See Appendix C, page 510.) Call them and ask for the name of your state wildlife commission or game biologist; you might have both. When you call the regional office ask for the Associate Director for Federal Assistance; he/she is there for just such inquiries.

The two major public health, safety and welfare questions about disturbance of a woodland are concerned with increasing erosion and flooding. The SCG and USGS can help you out if the state forester hasn't already done so. (State forestry divisions sometimes include hydrologists.) The SCS soils maps will tell you what kind of soil the woodland is on top of and how easily that soil is likely to be eroded. Get the maps from your local SCS office if you know where it is or call the state conservationist to find out. The USGS and state geological survey can tell you about the overall watershed that the area is a part of and can offer advice on the effects of a disturbance on flooding and sedimentation.

The local people who live close to and spend time in your wooded area area know something about it too. State DNR's and state Critical Areas Programs are concerned with wooded areas and they provide added resources to draw upon.

A SELECTED LIST OF

COMMUNITIES WITH WOODLANDS REGULATIONS

Alachua County, Florida
Board of County Commissioners
County Building
Gainesville, Florida 32601

Clearwater, Florida
Planning and Zoning Board
P.O. Box 4748
Clearwater, Florida 33518

Gainesville, Florida
Department of Community Development
Planning Division
P.O. Box 490
Gainesville, Florida 32601

Hayward, California
Planning Department
22300 Foothill Blvd.
Hayward, California 94541

Lake Tahoe, California
Tahoe Regional Planning Agency
P.O. Box 8896
South Lake Tahoe, California 92502

Leon County, Florida
Leon County Dept. of Environmental Services
1715 S. Gadsden Street
Tallahassee, Florida 32301

City of Novato, California
P.O. Box 578
Novato, California 94947

Oakland County, Michigan
Oakland County Planning Commission
1200 N. Telegraph
Pontiac, Michigan 48053

Saratoga, California
Planning Department
13
Saratoga, California 95070

Washoe County, Nevada
Regional Planning Commission
Reno, Sparks, and Washoe County
P.O. Box 1286
Reno, Nevada 89504

APPENDIX VII-a

LEON COUNTY ORDINANCE NO. 73 - 75

AN ORDINANCE RELATING TO THE PROTECTION OF CERTAIN TREES WITHIN LEON COUNTY: IDENTIFYING THE PURPOSE AND INTENT OF THE ORDINANCE; PROVIDING DEFINITIONS; ESTABLISHING OFFICIAL TREES; PROVIDING FOR TREE PROTECTION PRIOR TO DEVELOPMENT; ESTABLISHING PROTECTED TREES; ESTABLISHING A PERMIT PROCEDURE; PROVIDING FOR EXCEPTIONS; PROVIDING FOR VARIANCES; PROVIDING FOR APPEALS FROM DECISIONS OF THE ENVIRONMENTAL ADMINISTRATOR; PROVIDING FOR THE PAYMENT OF ATTORNEY'S FEES AND COSTS UPON APPEAL TO COURT OF COMPETENT JURISDICTION; ESTABLISHING PENALTIES; PROVIDING FOR SEVERABILITY; AND PROVIDING AN EFFECTIVE DATE.

WHEREAS, trees are an invaluable physical and psychological counterpoint to the urban setting, making life more confortable by providing shade and cooling the air, reducing noise levels and glare, breaking the monotony of man's developments on the land and, providing diverse environmental amenities, and;

WHEREAS, the use of requirements for tree removal and the resulting utilization of trees as landscape elements can effectively aid in the protection and conservation of the value of property; and

WHEREAS, the Board of County Commissioner of Leon County, Florida, has determined that requirements for protection of trees within Leon County are not only desirable but essential to insuring the health, welfare, and general well being of the community and therefore, that the required use of such requirements is a proper use of the police power; NOW THEREFORE,

BE IT ORDAINED BY THE LEON COUNTY BOARD OF COUNTY COMMISSIONERS OF LEON COUNTY, FLORIDA:

Section 1. Purpose and Intent. The purpose of this ordinance is to establish protective regulations for trees within Leon County in order to better control problems of flooding, soil erosion, air pollution, and noise and to make Leon County a healthier and safer place in which to live.

The intent of the ordinance is to encourage the protection of the maximum number of trees within the primary tree protection zone and of large, specimen, trees within the secondary tree protection zone. It is further the intent that the ordinances encourage in particular, the protection of the Live Oak (Quercus Virginiana) and floweringtrees for which Leon County is nationally recognized and which the County is in danger of losing unless protective measures are taken. The intent is not punitive; or to cause hardship to any individual, private or public company who use reasonable care and diligence to protect trees within Leon County.

Section 2. Definitions

Tree. Any woody plant having at least one well-defined stem at least four (4) inches in diameter measured at a height of 4½ feet above the natural grade and a more or less definitely formed crown.

Crown. The branches and foliage of a tree; the upper portion of a tree.

Primary Tree Protection Zone. That portion of any lot covered by the front, side, and rear yard setback areas as established and required by the Zoning Code of the City of Tallahassee and Leon County, Florida, as the same may, from time to time be amended.

Secondary Tree Protection Zone. All lands included in Districts R-1, Single Family Residential District; R-2, Single Family Residential District; R-3, Single and Two-Family Residential District; MH-1, Mobile Home and Single Family Residential District; E, Estate District; A-1, Agricultural District; and A-2, Agricultural District, as defined in the Zoning Code of the City of Tallahassee and Leon County, Florida, as the same may from time to time be amended, and any portion of a lot, regardless of zoning, not included within the primary tree protection zone.

Tree Removal. Removal of a tree means any act which causes a tree to die within a period of two years, including but not limited to, damage inflicted upon the root system by machinery, storage of materials, and soil compaction; changing the natural grade above the root system or around the trunk; damage inflicted on the tree permitting infection or pest infestation; excessive pruning; paving with concrete, asphalt, or other impervious material within such proximity as to be harmful to the tree.

Environmental Administrator. Agent of the Department of Environmental Services who is responsible for administering the provisions of this ordinance.

Section 3. Official Trees of Leon County. The Live Oak (Quercus Virginian) shall be the official shade tree and the Dogwood (Cornus Florida) shall be the official flowering tree.

Section 4. Protected Trees. No person, organization, society, association, corporation, or any governmental agency or representative thereof, directly or indirectly, shall, without first obtaining a permit as herein provided remove or relocate to another site; (1) any tree within a primary tree protection zone; or (2) any tree having a diameter of 36 inches or greater within a secondary tree protection zone.

Section 5. Permit Procedure.

A. Application permits for removal or relocation of individual trees or groups of trees covered herein shall be obtained by making application for permit to the environmental administrator. The application shall be accompanied by a written statement indicating the reasons for removal or relocation of trees and a general description of the trees to be relocated or removed.

B. On site inspection. Prior to the issuance of a permit for tree removal or relocation, the environmental administrator or his agent shall conduct an on-site inspection to determine whether or not such removal or relocation conforms to the requirements of this ordinance.

C. Criteria for removal or relocation.

1. The environmental administrator shall approve the permit if one or more of the following conditions is present:

   a. Necessity to remove trees which pose a safety hazard to pedestrian or vehicular traffic or threaten to cause disruption of public services;

   b. Necessity to remove trees which pose a safety hazard to buildings;

c. Necessity to remove diseased trees or trees weakened by age, storm, fire, or other injury.

d. Necessity to observe good forestry practices i.e., the number of healthy trees that a given parcel of land will support;

e. Necessity to remove trees in order to construct proposed improvements as a result of:

   1. Need for access around the proposed structure for construction equipment.

   2. Need for access to the building site for construction equipment.

   3. Essential grade changes.

   4. Surface water drainage and utility installations;

   5. Location of the proposed structure so as to avoid unreasonable economic hardship.

f. Necessity for compliance with other City of Tallahassee or Leon County County codes such as building, zoning, subdivision regulations, health provisions, and other environmental ordinances.

2. The environmental administrator may approve the permit based on the submission of proposed plans for landscaping whereby the applicant has planted or will plant trees to replace those that are proposed to be removed or relocated.

D. Application Review. The environmental administrator shall have seven (7) days after receipt of an application filed pursuant to this ordinance in which to approve or deny the requested permit. In the event that the environmental administrator denies an application, the administrator shall specify to the applicant in writing the reason for his action. If no final action with respect to an application is taken within the required seven (7) days, the application shall be deemed to have been granted.

Section 6. Exceptions. The terms and provisions herein shall apply to all real property lying within Leon County, except:

1. Provision for one access drive, a maximum of twenty-seven (27) feet in width, from the building site to each abutting street except that when storage lanes are required and so designated, the provision for an access drive may be thirty-nine (39) feet in width. These exceptions shall not apply to trees thirty-six (36) inches in diameter or greater

2. In the event that any tree shall be determined to be hazardous or dangerous condition so as to endanger the public health, welfare, or safety, and requires immediate removal without delay, verbal authorization by telephone may be given by the environmental administrator without obtaining a written permit as is otherwise required herein.

3. During the period of an emergency or any act of God, the requirements of this ordinance may be temporarily waived by the environmental administrator so that they will in no way hamper private or public work to restore order in Leon County.

4. All licensed plant or tree nurseries shall be exempt from the terms and provisions of this ordinance only in relation to those trees planted and growing on the premises of said licensee, which are so planted and growing for the sale or intended sale to the general public in the ordinary course of said licensee's business.

5. All trees in active commercial operation, including planted pine forests, shall be exempt from the terms and provisions of this ordinance provided such lands are used for bona fide agricultural purposes only.

6. Lands from which the removal of trees is necessary for a bona fide agricultural use.

Section 7. Variance.

The preservation of trees may be considered as a peculiar circumstance warranting relief from the literal application of the appropriate City or County Chapters and Codes, respectively the Subdivision Ordinance and Zoning Code. The owner may make application for a variance to avoid the removal, relocation, or destruction of a tree to the Board of Adjustment and Appeals which application for the variance shall be made without cost to the owner.

Section 8. Appeals from Decisions of the Environmental Administrator.

Any applicant aggrieved by a decision of the environmental administrator made pursuant to this ordinance may appeal to the Board of Adjustment and Appeals as provided.

Section 9. Attorney's Fees and Costs Upon Appeal to Courts of Competent Jurisdiction.

Leon County shall pay all reasonable costs of the proceedings in Courts of competent jurisdiction, upon an appeal from the Board of Adjustment & Appeals initiated by the aggrieved owner, including reasonable attorneys' fees to be assessed by that Court, except upon an appeal or review taken by the aggrieved landowner in which the judgment of the Board of Adjustment and Appeals is affirmed.

Section 10. Annual Review. This ordinance shall be reviewed annually by the Environmental Administrator, and specific amendments and revisions recommended to the Board of County Commissioners as conditions and technology change.

Section 11. Penalty.

Violation of any provision of this Ordinance or the conditions of a permit issued hereunder shall be unlawful, and any person violating any of the provisions of the Ordinance or the conditions of a permit issued hereunder, shall, upon conviction, be punished according to law. In sentencing, the court may consider the successful replacement of trees illegally removed.

Section 12. Severability.

If any section, subsection, clause, sentence, or phrase of this ordinance is for any reason held unconstitutional or invalid, the invalidity thereof shall not affect the validity of any of the remaining portions of this ordinance.

ORDINANCE NO. 1317

AN ORDINANCE OF THE CITY OF CLEARWATER, FLORIDA, REPEALING ORDINANCE NO. 1297 IN ITS ENTIRETY, AND ENACTING A NEW ORDINANCE PERTAINING TO THE REMOVAL OF CERTAIN TREES ON DESIGNATED PARCELS OF REAL PROPERTY WITHIN THE CITY OF CLEARWATER; SETTING FORTH THE PROPERTIES TO WHICH THE TERMS AND PROVISIONS OF THIS ORDINANCE SHALL APPLY AND THE REQUIREMENTS AND PROCEDURES FOR OBTAINING A PERMIT FOR REMOVAL OF TREES ON SAID PROPERTIES; PROVIDING FOR THE RELOCATION OR REPLACEMENT OF TREES WHERE CONSTRUCTION NECESSITATES THEIR REMOVAL; SETTING FORTH CERTAIN PRECAUTIONARY PROCEDURES FOR PROTECTING AND PRESERVING TREES ON PROPERTIES DURING CONSTRUCTION OF IMPROVEMENTS THEREON; SPECIFICALLY EXEMPTING CERTAIN SPECIES OF TREES FROM THE TERMS AND PROVISIONS OF THIS ORDINANCE; PROVIDING THAT THE CITY MANAGER MAY WAIVE OR VARY CERTAIN ESTABLISHED STANDARDS AND PROVISIONS OF THIS ORDINANCE DUE TO UNREASONABLE HARDSHIPS; PROVIDING FOR THE APPEAL OF THE DECISION OF THE CITY MANAGER OR THE PARKS DIVISION SUPERINTENDENT TO THE CITY COMMISSION CONCERNING THE ENFORCEMENT AND INTERPRETATION OF THE TERMS AND PROVISIONS OF THIS ORDINANCE; PROVIDING A PENALTY FOR FAILURE TO COMPLY HEREWITH; PROVIDING FOR REPEAL OF ORDINANCES OR PARTS OF ORDINANCES IN CONFLICT HEREWITH TO THE EXTENT OF SUCH CONFLICT; PROVIDING FOR THE SEPARABILITY OF THE PROVISIONS HEREOF AND PROVIDING FOR THE EFFECTIVE DATE OF THIS ORDINANCE.

WHEREAS, trees provide a setting with a variety of color unsurpassed in shade and hue; and

WHEREAS, trees are an invaluable psychological counterpoint to the man-made urban setting; and

WHEREAS, trees give shade and cool the land; and

WHEREAS, trees absorb a high percent of carbon dioxide and return oxygen, a vital ingredient to life; and

WHEREAS, trees are a valuable property asset that can affect an area economically; and

WHEREAS, removal of trees impairs benefits to existing property owners in the surrounding area and impairs economic stability and the value of improved and unimproved real property; and

WHEREAS, removal of trees causes increased surface drainage and soil erosion, causing increased municipal costs; and

WHEREAS, a shade tree ordinance is hereby promulgated for the purpose of promoting community welfare through regulating removal and destruction of trees prior to, during construction and during occupancy;

NOW, THEREFORE, BE IT ORDAINED BY THE CITY COMMISSION OF THE CITY OF CLEARWATER, FLORIDA:

Section 1. Ordinance No. 1297 passed on December 3, 1970, is hereby repealed in its entirety.

Section 2. Definitions. Tree is defined as any self-supporting woody plant of a species which normally grows to an overall height of a minimum of fifteen feet (15') in the City of Clearwater area.

Section 3. The terms and provisions of this ordinance shall apply to all real property presently situated in or subsequently annexed into the corporate limits of the City of Clearwater.

Section 4. It shall be unlawful for any person, without first obtaining a permit to do so as herein provided, to remove or effectively remove through damaging any tree with a trunk diameter of four inches (4") or more, said diameter being measured three feet (3') above grade.

Section 5. Any person wishing to obtain a permit to remove such a tree shall file an appropriate application with the Parks Division of the Parks and Recreation Department of the City of Clearwater. Said application shall include a topographic survey of said property if the change in elevation is greater than five feet (5') or if property is one acre or larger in size, or a site plan which shall include the following:

(a) Location of proposed driveways and other planned areas or structures on said site;

(b) All trees four inches (4") or over in trunk diameter measured three feet (3') above grade and identified as to type and species;

(c) Designation of all diseased trees and any trees endangering any roadway and pavement and trees endangering utility service lines;

(d) Designation of any trees to be removed and designation of trees to be retained;

(e) Any proposed grade changes which might adversely affect or endanger any trees on said site with specifications on how to maintain the trees.

Section 6. After filing, said application shall be field checked by the Parks Division of the City of Clearwater. The Parks Division, the City Engineering Department and the Building Department of the City shall review said application and shall consider and determine what effect it will have upon the drainage, topography, and the natural resources of the area, and shall consider these factors in granting or denying said application. Based upon a review of the above factors, said permit shall be either granted or denied by the Parks Division of the Parks and Recreation Department of the City of Clearwater.

Section 7. Where construction of structures or improvements of any real property necessitates the removal of such trees, the City Manager and/or the Parks Superintendent of the City may, as a condition for the approval of the application for removal, require that the owner either relocate or replace said tree or trees with comparable substitutes somewhere within the property lines of said property.

Section 8. It shall be unlawful for any person in the construction of any structures or other improvements to place material, machinery or temporary soil deposits within six feet (6') of any tree having a four inch (4") or greater trunk diameter measured three feet (3') above grade level and during construction the builder shall be required to erect suitable protective barriers around all such trees to be preserved. Also during construction no attachments or wires other than protective guy wires shall be attached to any of said trees.

Section 9. Specifically exempt from the terms and provisions of this ordinance are the following species of trees:

Melaleuca Leucadendra (Punk)
Casuarinaceae (Australian Pine)
Enterolobiom Cyclocarpum (Ear tree)
Jacaranda Acutifolia (Jacaranda tree)
Melia Azedarach (Chinaberry tree)

Section 10. No trees shall be removed from the public right of way except in accordance with Section 19-23 et seq. of the Code of the City of Clearwater, Florida.

Section 11. The City Manager may upon appropriate application vary or waive the terms and provisions of this ordinance due to unreasonable hardships in specific cases.

Section 12. Any person adversely affected by a decision of the City Manager or Parks Division Superintendent in the enforcement or interpretation of any of the terms or provisions of this ordinance may appeal such decision to the City Commission. Such appeal shall be taken by filing written notice thereof with the City Manager with a copy to the City Clerk within ten (10) days after the decision of the City Manager or the Parks Division Superintendent. Each such appeal shall be accompanied by a payment is sufficient amount to cover the cost of publishing and mailing notices of hearing or hearings.

Section 13. Any person, organization, society, association or corporation, or any agent or representative thereof, who shall violate the provisions of this ordinance shall be subject, upon conviction in the Municipal Court, to a fine not exceeding the sum of Five Hundred Dollars ($500.00), or imprisonment in the City Jail for not exceeding sixty (60) days, or by both such fine and imprisonment in the discretion of the Municipal Judge.

Section 14. All ordinances or parts of ordinances in conflict herewith are to the extent of such conflict hereby repealed, and specifically Ordinance No. 1297, passed on December 3, 1970.

Section 15. Should any part or provision of this ordinance be declared by a court of competent jurisdiction to be invalid, the same shall not affect the validity of the ordinance as a whole, or any part thereof other than the part declared to be invalid.

APPENDIX VII-c

ORDINANCE NO. 2143

BOARD OF SUPERVISORS, COUNTY OF SAN MATEO, STATE OF CALIFORNIA.

AN ORDINANCE AMENDING DIVISION VIII, NATURAL RESOURCES PROTECTION AND PART ONE, CHAPTER 1 THROUGH 14 AND ADDING CHAPTER 15 WHICH CONSISTS OF SECTIONS 10,000 ET SEQ., OF THE SAN MATEO COUNTY ORDINANCE CODE DEALING WITH THE REGULATION OF TIMBER HARVESTING IN THE UNINCORPORATED AREAS OF SAN MATEO COUNTY.

The Board of Supervisors of the County of San Mateo, State of California, DO ORDAIN as follows:

SECTION I. Division VIII, Part One, Chapters 1 through 14 are amended and Chapter 15 is added which consists of Section 10,000 et seq., are hereby amended and added to the San Mateo County Ordinance Code, to read as follows:

DIVISION VIII

NATURAL RESOURCES PROTECTION

PART I

REGULATION OF TIMBER HARVESTING

Chapter 1. PURPOSES AND POLICY. Section 10,000.

Chapter 2. DEFINITIONS OF TERMS USED. Section 10,050.

Chapter 3. PERMITS, RENEWAL, DENIAL, ISSUANCE OF A PERMIT, SPECIAL CONDITIONS. Section 10,200.

Chapter 4. APPLICATION, VARIANCE TO PROVISIONS, ACCEPTANCE OF APPLICATION, APPLICATION A PART OF PERMIT. Section 10,250.

Chapter 5. FEES, BONDS, SECURITY. Section 10,300.

Chapter 6. GENERAL TIMBER HARVESTING SPECIFICATIONS. Section 10,350.

Chapter 7. LOG HAULING ON PUBLIC ROADS. Section 10,400.

Chapter 8. CUTTING SPECIFICATIONS, LEAVE TREES, FELLING. Section 10,450.

Chapter 9. GENERAL CONSTRUCTION SPECIFICATIONS. Section 10,500.

Chapter 10. TRUCK ROADS. Section 10,550.

Chapter 11. TRACTOR TRAILS. Section 10,600.

Chapter 12. LANDINGS. Section 10,650.

Chapter 13. EROSION CONTROL. Section 10,700.

Chapter 14. FIRE HAZARD REDUCTION. Section 10,750.

Chapter 15. INSPECTIONS, VIOLATIONS, REVOCATION, APPEAL, SEVERABILITY. Section 10,800.

Chapter 1. PURPOSE AND POLICY

Section 10,000. PURPOSE. The provisions of this ordinance are enacted, in the interest of the welfare of the people of San Mateo County, that the timberlands of the county shall be protected and the ecological balance of such timberlands be preserved and that, in view of the proximity of the timberlands to urban centers of large and expanding population, the unique relationship of the timberlands to other areas of the county, and the unique nature of the timberlands themselves, the enactment of this ordinance is necessary in order to protect and preserve such lands through regulation of forest practices consisting of, but not limited to, matters relating to the following:

1. Soil erosion control
2. Water quality
3. Watershed control
4. Flood control
5. Sustained yield timber production
6. Stand density control
7. Reforestation methods
8. Mass soil movement
9. Submission of logging plans
10. Location and grade of logging roads and skid trails
11. Excavation and fill requirements
12. Fire prevention and control methods
13. Slash and debris disposal
14. Haul routes and schedules
15. Hours and dates of logging
16. Performance bond.

Section 10,001. POLICY. The Board of Supervisors, as a matter of policy, intends to continue to allow the harvesting of forest products under high performance standards from the private timberlands of this county. In adopting this ordinance, the county intends to establish performance standards which will allow for the continual production of forest products and encourage the maintenance of the open space objectives of the county.

Chapter 2. DEFINITIONS OF TERMS USED

Section 10,050. DEFINITIONS. In this ordinance the following definitions shall apply, unless the context clearly requires otherwise:

Section 10,051. D.B.H. Means the average diameter of a tree, outside the bark, at a point four and one-half feet above the average ground level.

Section 10,052. FOREST PRODUCT. Means logs, poles, posts, pilings, split products, fuelwood, chips, pulp, or sawdust.

Section 10,053. HARVEST AREA. Means that area on which timber harvesting is conducted including that area where soil and/or vegetation has been disturbed or damaged by the timber harvesting operation, including road firebreak construction.

Section 10,054. HAUL ROUTE. Means any public road within San Mateo County which is to be used to deliver forest products to a point of utilization or disposal.

Section 10,055. LANDING. Means that area where forest products are placed on trucks.

Section 10,056. LOPPING. Means severing, crushing, or spreading all slash, created by the current operations from felled, broken or pushed-over trees of any species so that no part of the slash remains more than thirty (30) inches above the ground.

Section 10,057. MINIMUM STOCKING. Means a well distributed stand of live and healthy coniferous trees which meets a combined count of six hundred (600) per acre as follows:

1. Six hundred (600) established coniferous trees per acre at least three (3) years of age and not more than four (4) inches d.b.h.; each tree to count as "one" toward meeting stocking requirements.

2. Two hundred (200) coniferous trees per acre over four (4) inches d.b.h. and not more than twelve (12) inches d.b.h.; each tree to count as "three" toward meeting stocking requirements.

3. One hundred (100) coniferous trees per acre over twelve (12) inches d.b.h. free from logging damage caused by the current operation, each tree to count as "six" toward meeting stocking requirements.

   Redwood root crown sprouts over one (1) foot height will be counted, using the average stump diameter one (1) foot above average ground level of the original stump from which the redwood root crown sprouts originate, counting one sprout for each foot of stump diameter to a maximum of six (6) per stump. Any countable redwood root crown sprout over one (1) foot in height but less than four (4) inches d.b.h. shall be counted as "one" toward meeting stocking requirements.

   At least fifty (50) percent of the minimum stocking count per acre (fifty (50) trees per acre) shall be composed of conifer trees over twelve (12) inches d.b.h. and maximum distance between conifer trees over twelve (12) inches d.b.h. shall not exceed fifty (50) feet as measured along the surface of the ground.

Section 10,058. OLD GROWTH TREE. Means a tree which is over 200 years old.

Section 10,059. OPEN BURNING. Means the burning of waste created by timber harvesting operations such as slash.

Section 10,060. SCENIC CORRIDOR. Means a band of land on either side of an officially designated Scenic Highway for which special development regulations have been established to protect its scenic values.

Section 10,061. SKIDDING. Means the movement of a forest product by physical means from the point of severing to a landing.

Section 10,062. SLASH. Means split product material, branches, limbs or stems of any species left in the harvest area as a result of current timber harvesting.

Section 10,063. SNAG. Means a standing dead tree or standing section thereof regardless of species.

Section 10,064. STANDS:

1. "Old Growth Stand" means a group of trees not less than ten (10) acres in size in which prior cutting has not removed more than 20% of the old growth conifer trees by number.

2. "Prior Cut Stands" means a group of trees which has had prior cutting which removed over 20% of the old growth conifer trees, or a stand, regardless of age of conifer trees, less than ten acres in size.

3. "Hardwood Stands" means a group of hardwood trees which are designated for timber harvest operations.

Section 10,065. STREAM COURSES. The various types of stream courses are defined as follows:

1. "Natural Water Course" means a trench worn in the earth by running water after rains as depicted by contour lines on the most recently published United States Geological Survey 7.5 minute series topographic map, or as is evident on the ground.

2. "Stream" means a natural watercourse designated by a solid line or dash and three dot symbol shown in blue on the most recently published United States Geological Survey 7.5 minute series topographic map or a natural watercourse that is carrying surface water within the harvest area during the conduct of timber harvesting.

3. "Intermittent Stream" means a natural watercourse that is not carrying surface water within the harvest area during the conduct of timber harvesting.

4. "Highwater Mark" - The highwater mark shall be considered as the natural watercourse of any stream.

Section 10,066. STUMP DIAMETER. Means the average top diameter of the stump of a cut tree outside the bark and shall be interpreted to be one inch greater than d.b.h.

Section 10,067. THINNING. Means the removal of trees less than 18 inches d.b.h. where removal will improve the growth of remaining trees or utilize trees that might otherwise die.

Section 10,068. TIMBER. Means trees of any species which are of sufficient size and quality to be capable of furnishing raw material used in the manufacture of forest products.

Section 10,069. TIMBER HARVESTING. Means the cutting or removal, or both, of timber or other forest products from timberlands for commercial purposes together with all the work incidental thereto such as road building, firebreak construction and fire hazard abatements, but excluding preparatory work such as tree marking and road flagging.

Section 10,070. TIMBER OWNER. Means any individual, copartnership, corporation or association that owns timber or timber rights on lands of another.

Section 10,071. TIMBERLAND. Means land upon which is growing a crop of trees of any species which are of sufficient size and quality to be capable of furnishing raw material used in the manufacture of lumber and other forest products.

Section 10,072. TIMBER OPERATOR. Means any individual, copartnership, corporation or association that is engaged in timber harvesting, except a person who is engaged in timber harvesting as an employee whose sole compensation consists of wages.

Section 10,073. TIMBERLAND OWNER. Means any person, copartnership, corporation or association that owns timberland.

Section 10,074. TRACTOR TRAIL. Means constructed trails or established paths used to deliver forest products from the forest to a landing by physical means.

Section 10,075. TRUCK ROAD. Means roads other than public roads used by trucks going to and from landings to transport logs and other forest products when specifically constructed for this purpose.

Section 10,076. WATERBREAK. Means a ditch, dike, or dip or combination thereof, constructed across tractor roads, skid trails, firebreaks and truck roads to effectively divert waterflow therefrom and aid in preventing erosion.

Chapter 3. PERMITS, RENEWAL, DENIAL, ISSUANCE OF A PERMIT, SPECIAL CONDITIONS.

Section 10,200. PERMIT. No one shall engage in timber harvesting within the County of San Mateo without first securing a permit therefor from the San Mateo County Planning Commission, or Board of Supervisors when an appeal is taken, or from the County Planning Director.

Permits shall be effective for only that area expected to be harvested during one permit year. Permits shall be effective for one year from the date of issuance. However, no permit shall be considered terminated or closed until April 1st of the year following completion of timber harvesting.

Section 10,201. PERMIT RENEWAL. A permit shall be considered as renewal of an existing permit when any one of the following circumstances exist and when application for a permit renewal is received at least three weeks prior to the expiration date of the existing, valid permit.

1. The application for renewal is for securing additional time to complete a timber harvest originally scheduled for completion in one year. The permittee makes no material change in the plans or specifications contained in the original application.

2. The applicant has submitted with the application for a one-year permit a management plan for the total ownership which, market conditions permitting, requires timber harvesting on a portion of the ownership at yearly intervals. The overall land management plan must have received Planning Commission approval at a previous meeting for an annual permit to be considered as renewal permit. Also, no material change in the land management plan is proposed by the applicant.

Section 10,202. PERMIT DENIAL. The Planning Director, Planning Commission or Board of Supervisors, may deny a permit or renewal permit for any of the following reasons:

1. If any applicant, i.e., timberland owner, timber owner or timber operator is not a real person in interest.

2. Material misrepresentation, or false statement in the application.

3. If any applicant, i.e., timberland owner, timber owner, or timber operator, is a permittee to a permit where violations to this ordinance or any variance granted under this ordinance exist on the date of consideration of a permit or permit renewal. To be considered a violation to a permit, the permittee must have been notified of violations and given a reasonable opportunity to correct such violations.

4. Refusal to allow inspection of the harvest area by authorized personnel.

5. A permit granted by the Planning Director, Planning Commission or Board of Supervisors, shall be considered immediately denied when any permittee, i.e., timberland owner, timber owner or timber operator, is changed or added to a permit after a permit is granted where such new or added permittee could not have received a permit under this Section.

6. If specifications in the application do not meet the provisions of this ordinance and the applicants do not apply for a variance to said provisions.

7. If granting the permit is deemed to be contrary to the best interests of the people of San Mateo County taking into consideration the policies and purposes expressed in this ordinance and the rights of private landowners to make reasonable use of their property.

Section 10,203. ISSUANCE OF A PERMIT OR A PERMIT RENEWAL BY PLANNING DIRECTOR. The County Planning Director may issue one-year timber harvesting permits or renew permits when the following situations exist:

1. no new truck roads are to be constructed;

2. no new tractor trails are to be constructed;

3. the retail value of the forest products after harvesting, skidding and splitting (if this is required to sell the product) will not exceed $5000.00 for 12 consecutive months from any one ownership.

Section 10,204. ISSUANCE OF PERMIT BY THE PLANNING COMMISSION. Permits which cannot be issued by the Planning Director, or are referred to the Planning Commission by the Planning Director, shall be issued only after a public hearing. Prior notice of said hearing shall be sent by the Planning Commission to property owners within 2500 feet of the parcel to be harvested, and to domestic water suppliers which watershed includes all or part of the parcel to be harvested.

Permits shall be issued upon a finding that the applicants have complied with and will adhere to the requirements of this ordinance, all special conditions and all applicable laws, and further, that there be no basis for denial under Section 10,202.

Section 10,205. SPECIAL CONDITIONS. The Planning Commission, or on appeal, the Board of Supervisors, shall have the authority to provide for any reasonable special conditions to a permit that it may deem necessary to carry out the purposes of this ordinance as provided in Section 10,000.

In the case of permits issued by the Planning Director, he shall have the same authority to set special conditions as does the Planning Commission.

Section 10,206. PROTECTION OF WATERSHEDS SERVING DOMESTIC WATER SUPPLIERS. In order to protect the health and welfare of the citizens of San Mateo County, and recognizing the critical role domestic water suppliers play in the county, the Planning Commission, or on appeal the Board of Supervisors, shall have the authority to establish stricter conditions to a permit for timber harvesting operation within the watershed above the points of diversion for such domestic water suppliers.

Chapter 4. APPLICATION

Section 10,250. APPLICATION - WRITTEN APPLICATION REQUIRED. An application for a timber harvesting permit shall be filed jointly by the timberland owner, timber owner and timber operator on a form provided by the Planning Commission. The information required on the application shall be limited to that which is reasonably necessary to evaluate the proposed timber harvesting operation which enforce the provisions of this ordinance.

All applications shall contain, but not be limited to, the following information:

1. Name, address and telephone number of the timberland owner and timber owner, and forestry consultant, if any.
2. Name, address and telephone number of the timber operator and on-the-premises supervisor. If not known at the time of filing, this information is to be submitted at least one week prior to commencement of timber harvesting. Also, the timber operator must sign the application at least one week prior to commencement of timber harvesting, agreeing to abide by all the provisions of this ordinance and any variance granted by the Planning Commission.
3. Signatures of the timberland owner, timber owner, and timber operator, agreeing to abide by the provisions of this ordinances and any variance granted thereunder and all applicable laws.
4. The San Mateo County Tax Assessor Parcel Number for the property on which timber harvesting will take place.
5. The dates within which timber harvesting will take place. If the exact date of commencement is not known at the time of filing, the Planning Commission shall be notified in writing at least one week prior to commencement of timber harvesting.
6. The approximate acreage of the harvest area, and the approximate acreage containing over 80% old growth conifer trees.
7. The cutting specification or specifications to be followed.
8. The type of forest product or products to be harvested.
9. The estimated volume to be harvested.
10. The desired haul route, together with points of disposal or utilization of forest products.
11. A copy of the fire plan required by Section 916.1 of the Forest Practice Rules for the Redwood Forest District.

12. Copies of the necessary permits and documents from the State Division of Forestry, the State Fish and Game Department, and the Bay Area Air Pollution Control District. If these documents are not available at the time of filing, they shall be submitted at least one week prior to commencement of the work authorized by the permit or document.

13. A statement authorizing the Planning Commission and persons authorized by it and representatives of the State Forester to enter and inspect the harvest area.

14. A statement as to whether or not tree marking is to take place.

15. If open burning is to take place, give size and location of slash and debris piles and approximate time necessary to consume a pile once ignited.

16. A statement explaining how property lines are marked and determined on the ground where any harvest area, proposed truck road or proposed tractor trail is to be located within 100 feet of a property line.

17. A statement as to what the timberland owner intends to do with his property following timber harvesting.

18. Where it is desired that the timber harvesting permit be issued by the Planning Director, a sworn statement by the timberland owner, timber owner, and timber operator is required that

    (a) no new truck roads are to be constructed,

    (b) no new tractor trails are to be constructed,

    (c) the retail value of the forest products after harvesting, skidding and, if necessary, splitting, will not exceed $5000.00 for 12 consecutive months from any one ownership.

19. A statement as to whether timber harvesting has occurred on any portion of the proposed harvest area in the ten-year period prior to filing this application.

Section 10,251. APPLICATION, TOPOGRAPHIC MAP REQUIRED. Together with the written application, the applicant shall submit an accurate topographic map of a scale not less than eight inches equals one mile, true scale printed upon the map. The following information must be presented upon the map:

1. property lines indicating total ownership upon which timber harvesting is to occur,

2. the harvest area (s) clearly indicating the type of timber stand (s) proposed for timber harvesting,

3. location of existing and proposed truck roads, showing whether designed to be permanent or temporary.

4. location of constructed tractor trails proposed within 400 feet of a stream.

5. location of drainage structures required on truck roads and tractor trails. Attached to the map and a part of the map shall be a specification list for temporary or permanent drainage structures.

   For temporary truck roads or tractor roads:

   (a) type of drainage structure;

   (b) if structure is to be a culvert, state diameter and length;

   (c) a statement as to the adequacy of the structure to carry anticipated flows.

   (NOTE: Temporary structures shall be removed prior to November 15 of each year and not replaced prior to April 1 of the year following. See Section 10,501-4.)

   For permanent truck roads:

   (a) type of drainage structure;

   (b) if structure is to be a culvert, state diameter, length and slope at which structure is to be placed;

   (c) contributing drainage area to the structure, in acres;

   (d) formula used and calculations made to determine culvert sizes;

   (e) schematic plans for structure if other than manufactured culverts;

   (f) a statement as to the adequacy of the structure to carry anticipated peak flows and the information used in arriving at such a statement.

6. location of all buildings in or within 500 feet of a harvest area.

7. location of existing and proposed log landings.

8. location of existing and proposed firebreaks.

9. location of all streams.

10. Location of all points of diversion, pumping or storage facilities for domestic water suppliers in or within 500 feet of a harvest area as shown on a map prepared by the County Health Department on file with the Planning Commission.

Section 10,252. FIELD WORK REQUIRED. In addition to filing Sections 10,250 and 10,251 above, the truck road, tractor trail and drainage structure locations as shown and required on the map shall be designated on the ground by flagging or other such means so that the county representative may examine the area and easily determine their proposed locations. Property lines shall also be determined on the site where any truck road, tractor trail or harvest area is proposed within 100 feet of a property line. Additional field work shall be required as in Sections 10,450-1 (b), 10,450-2 (b), 10,450-3 (b), 10,452 and 10,453.

The San Mateo County Planning Commission shall immediately forward a copy of the application for a permit to the Deputy State Forester, Monterey, California. In addition, a copy of the application for a permit shall be forwarded to the San Mateo County Parks and Recreation Commission.

Section 10,253. APPLICATION FOR VARIANCE TO PROVISIONS. The Planning Commission, or Planning Director for those permits to be issued by him, may approve, conditionally approve, or reject an application for a variance to any provision of this ordinance as an alternate to any requirement of this ordinance. Variance requests which are commensurate with the provisions of this ordinance and which accomplish silvicultural and protectional management of the land in conformance with the purpose and policy of this ordinance, in the opinion of the Planning Commission, will be approved.

Applications for variance must be accompanied by a statement of specific Section or Sections of this ordinance which are to be varied from, as well as where, within the harvest area, the variance would occur; what the applicant wishes to substitute in place of the rule or regulation; and what the advantages would be if the variance were to be granted. If necessary, a map may accompany the application for variance.

Section 10,254. APPLICATION FOR VARIANCE TO PROVISIONS - AFTER PERMIT IS GRANTED. Permittees may request variances to the provisions of this ordinance and/or modifications to the application approved by the Planning Commission by filing an application for variance and paying the filing fee of $50.

Section 10,255. ACCEPTANCE OF APPLICATION. All items, Sections 10,250, 10,251, 10,252 and 10,253, must be submitted or completed in a clear and adequate manner before an application for a permit will be accepted by the Planning Commission.

If, following office and field examination, the county representative determines that the information submitted or field work is not acceptable due to inaccuracy or poor workmanship, then the county representative shall inform the applicant of deficiencies and advise the Planning Commission at the appropriate public hearing, or the Planning Director if the permit is to be considered by him, that deficiencies are apparent and the county representative cannot properly evaluate the proposed timber harvesting operation until such deficiencies are corrected. The Planning Commission, or Planning Director, may then deny the permit for material misrepresentation in the application as required in Section 10,202-2 or continue the hearing to allow the applicant sufficient time to correct the deficiencies and the county representative to make recommendations to the Planning Commission.

Section 10,256. APPLICATION A PART OF THE PERMIT. All the information contained on the application for a timber harvesting permit which is not in conflict with this ordinance or any other rules of governmental agencies shall be a part of the permit. Those items contained on the application which are in conflict with this ordinance but for which an application for variance has been received and granted shall be a part of the permit. Information contained on the application which is in conflict with this ordinance and for which no application for variance has been received, or has been received but not granted, shall not be a part of the permit. Minor adjustments and variations from the application, Sections 10,250, 10,251 and 10,252, such as small changes in road and landing location, harvest area, cutting boundary, tree marking, etc., may be approved by the county representative. Substantial or significant changes must be brought before the Planning Commission as a request for a variance as per Section 10,254.

At the time of issuance, the applicants for a permit shall become jointly and individually the permittees and shall be responsible for compliance with this ordinance, special conditions, and provisions of any variance granted.

Chapter 5. FEES, BONDS SECURITY

Section 10,300. APPLICATION FEES. Applications for permits or permit renewals which may be issued by the Planning Director:

(1) Permit application shall be accompanied by a non-refundable fee of $25.00.

(2) Renewal permit application shall be accompanied by a non-refundable fee of $15.00.

Application for permits or permit renewals which must be considered by the Planning Commission:

(1) Permit application shall be accompanied by a non-refundable fee of $1.00 per acre of harvest area with a minimum charge of $25.00 and a maximum charge of $100.00.

(2) Renewal permit application shall be accompanied by a non-refundable fee of 50¢ per acre of harvest with a minimum fee of $25.00 and a maximum fee of $50.00.

Section 10,301. INSPECTION FEES. Inspection fees, for permits or permit renewals which may be issued by the Planning Director, shall be at the rate of 25¢ per acre of harvest area. The inspection fee is a one-time only charge for each acre of harvest area.

Inspection fees for permits or permit renewals which must be considered by the Planning Commission shall be at the rate of 50¢ per acre of harvest area with a minimum charge of $25.00. The inspection fee is a one-time only charge for each acre of harvest area.

Section 10,302. CASH DEPOSIT OR BOND. The Planning Commission shall require a cash deposit or bond or its equivalent payable to the County of San Mateo when it is deemed necessary to insure compliance with the provisions of this ordinance and any special conditions. Said cash deposit or bond shall be deposited by the timber operator in such amount as the Planning Commission may set provided such amount shall not exceed $7.500.00 per 100 acres of harvest area unless a larger amount is determined to be necessary to assure repair to county roads. Said cash deposit or bond shall encompass the permit period ending April 1 of the year following completion of timber harvesting.

Section 10,303. CASH DEPOSIT OR BOND OR ITS EQUIVALENT FOR EROSION CONTROL FACILITIES. The Planning Commission shall require the timberland owner to post a cash deposit or bond or its equivalent in an amount not to exceed $1,500 per 100 acres of harvest area. Said cash deposit or bond or its equivalent shall encompass two winter maintenance periods, November 15 through April 1, following termination of the timber operators period of responsibility. Should the timberland owner during the term of this bond sell the property upon which harvesting occurred, then it shall be his responsibility to inform the new property owner of the obligations contained in this ordinance.

Section 10,304. POSTING OF SECURITY, PAYMENT OF FEES. A timber harvesting permit shall not be valid and timber harvesting shall not occur until fees and cash 'eposits or bonds as required in Sections 10,301, 10,302 and 10,303 are posted with Planning Commission.

Chapter 6. GENERAL TIMBER HARVESTING SPECIFICATIONS

Section 10,350. APPLICABLE LAWS AND REGULATIONS. All the provisions, except as specified herein, of the following acts, statutes, ordinances and rules and regulations adopted thereunder are incorporated herein by reference and shall apply to all timber harvesting operations unless stricter provisions are contained in this ordinance:

1. State Forest Practice Act
2. State Fish and Game Code
3. State Fire Laws
4. Porter-Cologne Water Quality Control Act
5. Bay Area Air Pollution Control District
6. All other applicable federal, State and local laws and regulations.

Section 10,351. SPECIAL RULES FOR EAST SIDE OF SKYLINE BOULEVARD. The Planning Commission or, on appeal, the Board of Supervisors, may require the permittee to comply with special conditions over and above those found in this ordinance where any harvesting area is located on the east or bay side of Skyline Boulevard. The Board of Supervisors herewith finds that this area is critical to the health, welfare, environmental, ecological and aesthetic interests of the people of San Mateo County.

Section 10,352. PERMIT DOES NOT COVER SAWMILL ESTABLISHMENT. The issuance of a timber harvesting permit shall not include the right to establish a sawmill, either permanent or temporary.

Section 10,353. REGULATION OF NOISE. The Planning Commission or, on appeal, the Board of Supervisors, may regulate days and hours of timber harvesting when, in its opinion, such operations will create a serious public nuisance to resident population. Regulations will concern themselves with controlling those operations which create noise pollution.

Chapter 7. LOG HAULING ON PUBLIC ROADS

Section 10,400. LOG HAULING ON PUBLIC ROADS. Log hauling on public roads shall be in accord with the following rules:

1. Log hauling on public roads is not permitted on Saturdays, Sundays or on those days which are officially designated as non-working days for the following holidays: New Years Day, Washington's Birthday, Memorial Day, Independence Day, Labor Day, Thanksgiving Day and Christmas Day.
2. The Planning Commission or, on appeal, the Board of Supervisors, may restrict or not permit log hauling during periods of time when such hauling will interfere with commute traffic.
3. The Planning Commission or, on appeal, the Board of Supervisors, may conditionally accept or modify the haul route as specified in the management plan.
4. Permittee shall protect county roads from excessive damage and shall repair any damage beyond normal wear and tear resulting from his timber harvesting operation.

5. The Planning Commission or, on appeal, the Board of Supervisors, shall require the permittee to post special traffic signs and/or flagmen where determined to be necessary to prevent a serious hazard to traffic. After permit is granted county representative shall have the authority to regulate and/or require traffic signs and/or flagmen.

6. The Planning Commission may make any reasonable restriction on log hauling routes, times and dates that in its opinion will prevent hazardous conditions from arising during school busing times. The Planning Commission shall immediately upon the filing of an application for a timber harvesting permit, communicate in writing with the Superintendent of Schools, of all School Districts through which a haul route may be granted, requesting that the Commission be immediately informed in writing of the routes and hours of school busing and the dates when busing will occur on the haul routes and of any roadways the Superintendent of Schools considers to be hazardous to student transportation if log hauling is conducted.

Chapter 8. CUTTING SPECIFICATIONS, LEAVE TREES, FELLING

Section 10,450. LEAVE TREE REQUIREMENTS. Other than in Skyline Scenic Corridor and roadside areas, timber cutting must be done in accordance with the following specifications.

1. OLD GROWTH STANDS:

   (a) Leave 40% by number of those live coniferous trees 18 inches d.b.h. and larger, provided that the leave stand contains 25% of the 30 inches to 60 inches d.b.h. coniferous trees present prior to logging and 15% of those coniferous trees above 60 inches d.b.h. present prior to logging. No cutting of conifer trees less than 18 inches d.b.h. shall occur. In addition to meeting the above requirement, each old growth stand must meet the seed tree requirement as stated in Section 913.1 of the Forest Practice Rules for the Redwood Forest District. The timber operator is encouraged to leave said coniferous trees over 30 inches d.b.h. in such locations and grouped in such a manner as to minimize the risk of windthrow and maximize streamside, scenic and recreational values.

   (b) At the option of the applicant, trees desired to be cut shall be marked and the marking subject to approval by the Planning Commission. Stump marks shall be provided. Applicant shall advise the county representative well in advance of the Planning Commission hearing if he determines to premark.

2. PRIOR CUT STANDS:

   (a) Leave 40% by number of those live coniferous trees measuring 18 inches and larger d.b.h. present prior to timber harvesting. Thinning of coniferous trees over 12 inches but less than 18 inches d.b.h. is permissible from dense thickets as long as leave trees in such thickets shall number 50% and be the dominant trees with full, well formed crowns on at least two of the four faces of the crown. No point within the cut area shall be more than 75 feet from a conifer leave tree over 12 inches d.b.h. located within the cut area. Further provided, no point within the cut area shall be more than 40 feet from a conifer or hardwood leave tree ten inches or more in d.b.h.

(b) At the option of the applicant, trees desired to be cut shall be marked and the marking subject to approval by the Planning Commission, or Planning Director as the case might be. Stump marks shall be provided. Applicant shall advise the county representative well in advance of the Planning Commission hearing if he determines to premark.

3. HARDWOOD STANDS:

(a) Leave 40% by number of those live hardwood trees measuring four inchese and over d.b.h. and 50% by number of those hardwood trees under four inches d.b.h. present prior to timber harvesting. In addition, all hardwoods over 36 inches d.b.h. shall be left uncut and undamaged by the current operation. No point within the cut area shall be more than 75 feet from a hardwood leave tree over four inches d.b.h. located within the cut area.

(b) At the option of the applicant, trees desired to be cut shall be marked and the marking subject to approval by the Planning Commission or Planning Director as the case might be. Stump marks shall be provided. Applicant shall advise the county representative well in advance of the Planning Commission hearing if he determines to premark.

Section 10,451. SCENIC AND ROADSIDE CORRIDOR SPECIFICATIONS. Timber harvesting within specified roadside zones shall be conducted in a manner which will reduce the visual impact of timber harvesting on passing motorists.

Consideration shall be given by the Planning Commission and the Board of Supervisors to the fact that these areas are already designated as scenic corridors in some cases and will be in other cases. The proposed or potential future uses will be considered in making a determination of cutting requirements.

1. SCENIC CORRIDOR SPECIFICATIONS. The permittee may be required to comply with special conditions attached to his permit covering timber harvesting operations on any portion of the harvest area which is within the designated Skyline Scenic Corridor. Within this scenic corridor, additional restrictions will, if deemed necessary, concern themselves with maintaining the scenic corridor in an aesthetically acceptable condition. Timber harvesting within the scenic corridor may be restricted up to the following limits:

(a) The permittee shall be permitted to remove at least 50% of those conifer trees measuring 32 inches d.b.h. and larger, and at least 50% of those conifer trees measuring less than 32 inches d.b.h. and more than 18 inches d.b.h. or at least 50% of those hardwood trees measuring 36 inches d.b.h. and less. The Planning Commission shall have the discretion of determining what trees must remain following timber harvesting. However, the leave by volume shall not be required to exceed 50% of the before harvest volume.

(b) The location of truck roads, tractor trails, and/or landings must meet the approval of the Planning Commission prior to construction.

2. ROADSIDE CORRIDOR SPECIFICATIONS. Timber harvesting within 100 feet, as measured along the ground surface, from the edge of the road berm along both sides of all public roads (except Skyline Boulevard) shall be conducted as set forth below, where necessary to protect aesthetic values.

(a) The permittee shall be permitted to remove at least 50% of those conifer trees measuring 32 inches d.b.h. and larger and at least 50% of those conifer trees measuring less than 32 inches d.b.h. and more than 18 inches d.b.h. or at least 50% of those hardwood trees measuring 36 inches d.b.h. and less. The Planning Commission shall have the discretion of determining what trees must remain following timber harvesting. However, the percent leave by volume shall not be required to exceed 50% of the before harvest volume.

(b) The location of truck roads, tractor trails, and/or landings must meet the approval of the Planning Commission prior to construction.

(c) In lieu of the roadside corridor specified in Section 10,451-2, the county representative may delineate on the ground that area where the ground surface is readily visible, or will be readily visible following timber harvesting, to passing motorists, provided that the area contained in such visual impact area shall not exceed the acreage contained in a roadside corridor the length of the harvest area road frontage with a fixed width of 100 feet. Upon establishment of a visul impact area, the requirements of 10,451-2 (a) and (b) shall apply only to the visual impact area.

3. FIELD WORK REQUIRED. For the county representative to properly advise the Planning Commission, it is required that the applicant mark trees desired to be cut, and flag proposed truck roads, tractor trails, and landings.

So as not to unnecessarily delay the consideration of a timber harvesting permit before the Planning Commission, the applicant is advised to mark trees and flag roads, trails and landings prior to submission of an application for a timber harvesting permit. A county representative will assist in this work if given sufficient advance notice.

Section 10,452. CUTTING TO MORE THAN ONE CUTTING RULE. If more than one cutting rule shall be used within any individual timber harvesting operation or harvest area, a line delineating the area to be cut under provisions of each shall be clearly defined on the ground by paint or other means for the inspection of the county representative prior to the Planning Commission hearing for the timber harvesting permit.

Section 10,453. EXCEPTIONS TO CUTTING RULES. The cutting requirements provided herein shall not prohibit the cutting or removal of trees for the purpose of clearing rights-of-way, log landings or firebreaks, or the cutting or removal of competing hardwood trees from a predominant conifer stand for the purpose of promoting the growth of the conifer trees.

A timber harvesting permit is required for such removal of competing hardwoods when the hardwood is removed as a forest product.

Section 10,454. LEAVE TREES AND SPACING. For all cutting rules, leave trees shall be thrifty vigorous trees with well formed full crowns, free from damage caused by timer harvesting operations. With the exception of old growth conifer leave trees over 30 inches d.b.h., all leave trees shall be well distributed within the harvest area. For the purpose of these cutting rules, well distributed shall mean the spacing of leave trees on any reasonably sized area of less than five acres and shall reflect the before-harvest distribution of trees, reduced by a factor equal to the permissible cut.

Section 10,455. PROTECTING LEAVE TREES. For the purpose of protecting from damage those leave trees and young growth required to be left standing after timber harvesting and fire hazard abatement, as required in this ordinance and to maintain the productivity of the forest lands and soils, every timber operator shall exercise due diligence in the management and operation of felling, skidding and loading of timber or any activity connected therewith, to prevent damage to those leave trees and young growth.

Section 10,456. FELLING: Trees shall be felled to the fullest extent possible that topography lean of tree, landings, utility lines, local obstructions and safety factors permit, in line with skidding direction, away from roads, and with minimum damage to leave trees and reproduction.

Trees shall be felled so that the branches will not enter a stream.

Section 10,457. PREVIOUS CUT STANDS. On timber harvesting operations in which cutting has occurred within ten years preceding the current operation, stumps which are the result of cutting trees within the preceding ten years will be counted as trees cut during the current operation in determining percent of trees cut. This paragraph shall be null and void ten years after adoption of this ordinance.

Section 10,458. FREQUENCY OF TIMBER HARVEST OPERATIONS. Conifer and hardwood stand timber harvesting shall be limited to only one operation in any ten-year period of time, provided that, following the ten-year period, minimum stocking has been obtained. In the case of hardwood stands, substitute the word "hardwood" where conifer or redwood appears in the definition of minimum stocking. To determine if minimum stocking has been obtained, the applicant or his representative shall accompany the county representative on a joint inspection of the proposed harvest areas.

Section 10,459. TANBARK OPERATIONS PROHIBITED. Peeling of tanoak trees for the production of bark for commercial purposes is prohibited.

Chapter 9. GENERAL CONSTRUCTION SPECIFICATIONS

Section 10,500. LOCATION. The location of truck roads, tractor trails, firebreaks and landings shall not:

1. Adversely effect the stability of property owned by others;
2. Cause soil to be deposited on property owned by others;
3. Cause excessive erosion and landsliding;
4. Contribute significantly to the degredation of water quality.

Section 10,501. STREAM CROSSINGS. All truck road and tractor trail crossings of streams will be provided with temporary or permanent drainage structures which will adequately carry water under the road or trail without the water being contaminated or polluted with soil or organic material throughout the entire period of timber harvesting. All stream crossing structures shall be installed concurrently with truck road and tractor trail construction. All stream crossings shall be subject to approval by the Planning Commission or, on appeal, the Board of Supervisors.

1. Stream crossings which are to be placed in streams which are supporting a fish population at the location of the crossing shall be installed so as not to prohibit the passage of fish.

2. Permanent drainage structures shall be approved only if their installation, sizing, and location meets with the approval of the Planning Commission.

3. Materials to be used for permanent stream crossings must meet the approval of the Planning Commission.

4. Temporary drainage structures and associated fill material shall be removed on or before November 15 of each year and not replaced prior to April 1 of the following year.

Section 10,502. INTERMITTENT STREAM CROSSING. Unless provided with permanent drainage structures as provided for in Section 10,501, all fill material deposited for truck road or tractor trail crossings of intermittent streams shall be removed prior to November 15 and not replaced prior to April 1 of the following year. In lieu of removing fill, the county representative may require an alternate method of providing a near erosionless channel through which water shall be diverted.

Chapter 10. TRUCK ROADS

Section 10,550. LOCATION. All truck road locations shall be subject to the approval of the Planning Commission. Truck roads which are approved as to location by the Planning Commission and constructed in accordance with this Chapter shall be exempt from the San Mateo County On-site Grading Ordinance. Roads which are not to be or cannot be constructed in accordance with these specifications may require that on-site grading permits be obtained prior to construction, or be subject to any special conditions deemed appropriate by the Planning Commission.

Section 10,551. USE OF EXISTING ROADS. Truck roads existing prior to application for a timber harvesting permit may be used regardless of location when, in the opinion of the Planning Commission their use will result in less ground disturbance and stream contamination than a new road constructed in accordance with this Chapter.

Section 10,552. ROAD CONSTRUCTION ON STEEP SLOPES. Truck roads shall not be constructed on slopes where the cross-slope exceeds 70% or have road grades that exceed 20% except that these percentages may be exceeded by a factor of 50% on 100 feet of each 1000 feet of raod construction.

Section 10,553. WIDTH OF ROADS. Truck roads shall be constructed to singlelane width (approximately 15 feet) with turnouts at reasonable intervals. Both roads and turnouts shall be no wider than necessary to permit safe passage of log trucks and equipment.

Section 10,554. ROAD CUT BANKS. Truck roads shall be constructed with no overhanging banks and any trees with more than 25% of the root surface exposed by reason of road construction shall be felled concurrently with timber harvesting. Where road cuts exceed 6 feet in vertical height all trees over 6" d.b.h. for a distance of 8 feet as measured along the ground at right angles from the top of cut may be required to be cut by the county representative.

Section 10,555. SWITCHBACKS. Switchbacks, 180° turns, on truck roads shall be constructed using a radius which will give an effective 1½:1 slope between the inside edge of lower roadway to outside edge of upper roadway and not be constructed on slopes over 40 percent as measured directly between the entrance and exit points of the proposed switchback.

Section 10,556. FOLLOW CONTOUR OF LAND. Roads are to be laid out and constructed such a manner that the general contours of the land are utilized to the fullest extent possible to avoid excessive cuts, fills and road grades that will increase erosion.

Chapter 11. TRACTOR TRAILS

Section 10,600. LOCATION. Pursuant to the provisions of this ordinance, the location of all tractor trails shall be subject to the approval of the Planning Commission or county representative. Advance flagging and approval of constructed tractor trails shall be required wherever necessary to ensure that the location and design meets the provisions of this ordinance.

Section 10,601. LIMITATIONS. Tractor trails shall be limited in number and width consistant with sound forest management practices.

Section 10,602. SKIDDING. Due diligence shall be exercised in skidding operations to prevent damage to leave trees reproduction and other soil protective vegetation.

Section 10,603. STREAM CROSSINGS. All tractor trail stream crossings shall be temporary.

Section 10,604. PARALLEL TO SLOPE. To minimize soil excavation, tractor trails shall be constructed perpendicular to the contour as nearly as practicable.

Section 10,605. PARALLEL TO WATERCOURSES. Tractor trails shall not be constructed parallel to natural watercourses where such construction will likely cause major soil movement.

Section 10,606. EXISTING TRACTOR TRAILS. Tractor trails existing prior to application for a timber harvesting permit may be used regardless of location when, in the opinion of the county representative or Planning Commission, their use will result in less ground disturbance and stream contamination than a new trail constructed in accordance with this Chapter.

Chapter 12. LANDINGS

Section 10,650. LOCATION. Pursuant to the provisions of this ordinance, the location of all landings shall be subject to the approval of the Planning Commission or county representative. Advance flagging and approval of landings shall be required wherever necessary to ensure that the location and design meet the provisions of this ordinance.

Section 10,651. LIMITATIONS. Landings shall be kept to the minimum in size and number consistant with sound forest management practices.

Section 10,652. SLOPE LIMIT. Landings shall not be constructed where the cross-slope exceeds twenty-five percent.

Section 10,653. OPEN AREA. Whenever practicable, landings shall be constructed in open areas.

Chapter 13. EROSION CONTROL

Section 10,700. MAINTENANCE OF WATER QUALITY. Not withstanding any provision of this ordinance, it shall not be construed in any way to condone any activity which causes significant degradation of water quality.

Section 10,701. EROSION CONTROL. Tractor trails, landing, truck roads and firebreaks shall be so located, constructed, used and left after timber harvesting that water flow therefrom and water flow in natural watercourses shall limit erosion to a reasonable minimum, and not impair the productivity of the soil or appreciably diminish the quality of the water.

Section 10,702. STREAMSIDE BUFFER STRIP. Construction of truck roads, tractor trails and landings shall only be permitted when it is clearly shown that there is a protective strip between the proposed construction and the stream having sufficient filter capacity to effectively remove waterborne sediment to prevent any serious risk that construction and use of said facilities will cause significant degradation of water quality. Where it is determined that the filter capacity of the protective strip is insufficient, additional erosion control may include, but is not limited to, any or all of the following:

1. Increased width of the protective strip;
2. Decreased interval between waterbreaks;
3. Treatment of the travelled surface to protect soil from erosion;
4. Treatment of fill slopes to protect soil from erosion which may include installation of down drains;
5. Installation of slope obstructions between the toe of the fill and the stream;
6. Seeding or planting of disturbed areas where bare soil is exposed to protect the soil from erosion.

If, in the opinion of the Planning Commission, an adequate protective strip cannot be provided then the truck road, tractor trail, and/or landing shall not be approved.

Section 10,703. WATERBREAKS. Waterbreaks shall be constructed in all truck roads, tractor trails and firebreaks no later than November 15. Waterbreaks shall:

1. Be located in minimal fill areas;
2. Be effective in diverting surface water from the truck road, tractor trail or firebreak;
3. Provide unrestricted discharge into an area having sufficient filter capacity to effectively remove waterborne sediment to prevent a serious risk of causing significant degradation of water quality;
4. Be installed at such intervals as is necessary to reasonably prevent surface water on or from such truck roads, tractor trails and firebreaks from accumulating in sufficient volume or accelerating to sufficient velocity to cause excessive erosion.

Section 10,704. WATERBREAK INTERVAL. The following table will aid in determining waterbreak interval:

1. On grades of 10% or less - at intervals of 100 to 200 feet;
2. On grades of 11-25% - at intervals of 75 to 150 feet;

3. On grades of 26-49% - at intervals of 50 to 100 feet;

4. On grades of 50% or more - at intervals of 30 to 75 feet.

Advance flagging of waterbreak location shall be required wherever necessary to insure that the location and spacing of the waterbreaks is adequate to prevent water flow from creating a serious risk of causing significant degradation of water quality.

Section 10,705. WATERBREAKS ON PERMANENT ROADS. On permanent truck roads, waterbreaks shall be cut a minimum of 12 inches into the firm road surface and shall be constructed so that they will not be rendered ineffective by the passage of motorized vehicles. Such breaks may be spread over sufficient length of road to permit passage of vehicles.

Section 10,706. WATERBREAKS ON TEMPORARY TRUCK ROADS, TRACTOR TRAILS AND FIREBREAKS. On temporary truck roads, tractor trails and firebreaks, waterbreaks shall be cut a minimum of six inches into the firm soil and shall have a continuous firm embankment of suffient height so as to discourage attempts to pass over or around them with motorized vehicles.

Section 10,707. OUTSLOPED DRAINAGE. Outsloped drainage structures may be constructed in lieu of waterbreaks. Such structures may be outsloped dips or the entire travelled surface may be outsloped with sections of berm removed at periodic intervals to permit water to flow from the travelled surface. (Note: Location and spacing of outflow points is the same as for waterbreaks.)

Section 10,708. EMERGENCY MEASURES. In an emergency, should weather and/or soil conditions prevent installation of waterbreaks as specified above prior to November 15, then the drainage of truck roads, tractor trails and/or firebreaks shall be maintained by hand to prevent excessive erosion until permanent facilities can be installed.

Section 10,709. WHEN WATERBREAKS ARE NOT FEASIBLE. Wherever terrain or any other factor precludes proper diversion of waterflow from tractor trails as required herein, slash shall be scattered on said tractor trails in sufficient quantity to retard waterflow thereon and hold erosion to a minimum.

Section 10,710. BERMS. Roadside berms shall be constructed where necessary to guide surface waterflow to the point of planned diversion and prevent unneccessary erosion of fills and side cast material.

Section 10,711. SLOPE STABILIZATION. To provide an effective cover, all side cast and fill material that exceeds five feet in slope distance at right angles to the road shall be seeded, planted or treated for prevention or reduction of soil erosion. Such work shall be completed within 15 days following the first rain in the fall season, but in no case later than November 15.

Section 10,712. STREAM PROTECTION. Streams shall be kept free of slash.

Section 10,713. REMOVAL OF TEMPORARY STREAM AND INTERMITTENT STREAM CROSSINGS. All temporary drainage facilities and associated fill material shall be removed from temporary truck road and tractor trail crossings of streams and intermittent streams prior to November 15 and not replaced before April 1 of the following year.

Section 10,714. WINTER SHUT-DOWN PERIOD. The operation of heavy equipment such as trucks and tractors within the harvest area is prohibited between November 15 and April 1. During this period, when the soil is not so wet that operation of heavy equipment may cause excessive damage to the land, the county representative may authorize the operation of heavy equipment. Such authorization shall be in writing and shall be based on the individual circumstances of each timber harvesting operation and may be revoked by the county representative at any time either by telephone, in writing or in person. Once revoked, said authorization can be reinstated only in writing by the county representative.

Section 10,715. SPECIAL RULES FOR WINTER OPERATIONS AUTHORIZED PER SECTION 10,714.

1. Use of temporary truck roads is prohibited

2. The installation of temporary stream crossings is prohibited

3. All skidding operations shall be confined to that area designed to deliver forest products to one landing. All erosion control structures, bars, dips, and the like required by this ordinance shall be installed prior to vacating one landing and moving to another.

4. The permittees shall install all erosion control structures required by this ordinance concurrently with the timber operations.

Section 10,716. RESPONSIBILITY FOR INSTALLATION AND INITIAL MAINTENANCE OF EROSION CONTROL FACILITIES. The timber operator is responsible to ensure that all erosion control facilities are constructed prior to November 15 of the current year and that said erosion control facilities are maintained in affective condition through April 1 of the following year. Should the timber operator fail, after being contacted in writing, to provide the required erosion control measures, the county is authorized to perform the required work to correct the violation and to assess the timber operator accordingly, and charge all reasonable costs against the timber operator's security deposit.

Section 10,717. RESPONSIBILITY FOR CONTINUED MAINTENANCE OF EROSION CONTROL FACILITIES. Upon expiration of timber operator's period of responsibility, the timberland owner is responsible to ensure that erosion is effectively controlled. Should the timberland owner fail, after being contacted in writing, to effectively control erosion, the county is authorized to perform the work required by this ordinance and to assess the timberland owner accordingly, and charge all reasonable costs against the timberland owner's security deposit. Said security deposit, as per Section 10,303, shall encompass two years following completion of the timber operator's term of responsibility.

Section 10,718. CONTINUING RESPONSIBILITY OF TIMBERLAND OWNER. After the termination of the two-year maintenance period, the landowner shall be responsible for corrections of any damage to surface waters as the result of the timber harvesting operations.

Chapter 14. FIRE HAZARD REDUCTION

Section 10,750. SLASH TREATMENT. All slash created by current timber harvesting shall be lopped in no case later than April 1 of the year following the creation of the slash.

Section 10,751. SLASH TREATMENT ADJACENT TO ROADS AND BUILDINGS. The area within 50 feet, as measured along the ground surface, of dwellings, appurtenant structures and the edge of travelled surface of public roads shall be kept free of slash.

Section 10,752. SNAGS. All snags over twenty feet in height and eight inches d.b.h. within the harvest area shall be felled prior to April 1 of the year following timber harvesting.

Section 10,753. FIREBREAKS. Wherever practicable and useful, considering factors such as soil erosion, practicality of defending the firebreak in event of fire, extent of uncontained slash, proximity of more defensible existing barries and other factors relating to the effectiveness of and need for firebreaks vs. the extent of damage and disturbance caused by their construction, all areas of slash shall be concurrently with timber harvesting, broken-up into blocks surrounded by firebreaks of not less than fifteen feet in width from which all inflammable material has been cleared. Existing roads, trails, streambeds or other natural fire barriers may be considered as firebreaks when not less than the minimum width and clear of all inflammable material as required herein. Streams may be considered as firebreaks regardless of width.

Section 10,754. FIREBREAKS ON WINTER OPERATIONS. Areas of slash created between November 15 of one year and April 1 of the following year shall have firebreaks constructed concurrently with timber harvesting provided however, that in the event construction of the required firebreaks concurrently with timber harvesting is rendered impossible as a result of weather conditions, the required firebreaks shall be constructed as soon thereafter as weather conditions will permit, but in no event later than June 15 of the aforesaid following year to constitute compliance with this rule.

Section 10,755. PROTECTING LEAVE TREES. Slash and debris shall not be bunched or bulldozed adjacent to leave trees, during and after construction of truck roads, tractor trails, landings and firebreaks.

Section 10,756. BURNING OF SLASH AND DEBRIS. All open burning shall be done only with the approval of the State Forester and the Bay Area Air Pollution Control District. Open burning will be subject to certain meteorological conditions as specified by the State Forester and the Air Pollution Control Officer.

Chapter 15. INSPECTIONS, VIOLATIONS, REVOCATION, APPEAL

Section 10,800. PERMISSION TO ENTER HARVEST AREAS. The filling for application for a timber harvesting permit shall constitute a grant of permission for county personnel concerned with administering this ordinance to enter the subject harvest area at their convenience from the date of application to the termination of the waterbreak maintenance period for the purpose of inspecting said harvest area for compliance with these rules and applicable law. The county will be supplied with a key or combination to locks installed on access control devices or shall be permitted to install a county lock.

Section 10,801. INSPECTIONS. The Planning Commission shall cause sufficient inspections to be made of the harvest area to assure compliance with the provisions of this ordinance and the requirements of applicable law. Upon completion of any inspection, the permittee shall be given a written notice of any violations observed at the time of inspection for correction thereof.

Section 10,802. FINAL INSPECTION. Upon notification by the permittee that operations have been completed upon any harvest area, the Planning Commission shall cause a final inspection to be made of said area. At the completion of any final inspection, the Planning Commission shall give notice to the permittee of any violations for correction thereof.

Section 10,803. VIOLATIONS. Violations of this ordinance shall be punished as provided for in Sections 1200-1203 of the San Mateo County Ordinance Code.

Section 10,804. OPERATING WITHOUT PERMIT - MISDEMEANOR. Any timberland owner, timber owner or timber operator who engages in timber harvesting or conspires with another to engage in timber harvesting without a valid timber harvesting permit to do so from the Planning Commission or the Planning Director is guilty of a misdemeanor.

Section 10,805. PERMIT REVOCATION. The Planning Commission may, upon giving notice to the permittee, revoke any permit, or revoke and reinstate any permit upon suitable conditions, if the timber operator fails, neglects or refuses to fulfill any of the requirements of this ordinance or conditions of the permit or violates any provisions of applicable law. Due to the very nature of timber harvesting, minor violations or variations to rules and regulations will occur from time to time. Infrequent, minor violations and variations will be documented by the county representative and administered at staff level. Should repeated violations, or a major violation occur, then the county representative shall bring the matter to the Planning Commission after proper notices have been given. The Planning Director may request the District Attorney (without approval of the Planning Commission or the Board of Supervisors) to secure an injunction to stop all timber harvesting should time be of the essence. the Planning Director shall immediately notify the Planning Commission and Board of Supervisors in writing of his action.

Section 10,806. APPEAL. The applicant, or any other person who is aggrieved by the issuance or non-issuance of the permit or any conditions thereof, may appeal.

1. Permits considered by the Planning Director may be appealed to the Planning Commission by filing a written protest with the Secretary of the Planning Commission within ten days of the issuance or denial of said permit.

2. Permits considered by the Planning Commission may be appealed to the Board of Supervisors by filing a written protest with the Secretary of the Planning Commission within ten days from issuance or denial of said permit. The Board of Supervisors shall hear such appeal within 30 days, and its decision shall be final.

Section 10,807. SEVERABILITY. If any section, subsection, paragraph, sentence, clause or phrase of this ordinance is for any reason held to be invalid or unconstitutional, such validity or constitutionality shall not affect the validity or constitutionality of the remaining portions of this ordinance, it being expressly declared that this ordinance and each section, subsection, paragraph, sentence, clause and phrase thereof would have been adopted, irrespective of the fact that one or more other section, subsection, paragraph, sentence, clause or phrase be declared invalid or unconstitutional.

Section 2. EFFECTIVE DATE. This ordinance shall be and is hereby declared to be in full force and effect as of thirty days from and after the date of its passage and shall be published once before the expiration of fifteen (15) days after its passage, with the names of the Supervisors voting for and against the same in a newspaper of general circulation published in the County of San Mateo.

APPENDIX VII-d

______________________ TOWNSHIP, COUNTY OF OAKLAND, STATE OF MICHIGAN

TOWNSHIP ORDINANCE NO. ____________________

FORESTRY AND WOODLANDS PROTECTION ORDINANCE

EFFECTIVE DATE: ______________

An ordinance to protect the trees and related natural resources of ____________ Township, Oakland County, Michigan; to regulate the use of land areas subject to development; to protect economic property values, aesthetic and recreational values, and other natural resource values associated with the growth of trees and other vegetation in this township; to provide for permits for the use of these resource areas; and to provide for penalties for the violation of this ordinance adopted to secure the public health, safety, and general welfare under the authority of Act 246 of the Public Acts of 1945, as amended.

The Township Board of the Township of _________________________, County of Oakland, State of Michigan, ORDAINS:

ARTICLE I - SHORT TITLE

This ordinance shall be known and may be cited as the _______________________ Township Forestry and Woodlands Protection Ordinance.

ARTICLE II - PURPOSE

Section 1. Consistent with the letter and spirit of Act 246 of the Public Acts of 1945, the Township Board of ___________________ Township finds that rapid growth, the spread of development, and increasing demands upon natural resources have had the effect of encroaching upon, despoiling, or eliminating many of the trees and other forms of vegetation and natural resources and processes associated therewith which if preserved and maintained in an undisturbed and natural condition, constitute important physical, aesthetic, recreation and economic assets to existing and future residents of the Township. Specifically, the Township finds (i) that woodland growth protects public health through the absorbtion of air pollutants and contamination, through the reduction of excessive noise and mental and physical damage related to noise pollution, through its cooling effect in the summer months; (ii) that woodlands provide for public safety through the prevention of erosion, siltation, and flooding; and (iii) that trees and woodland growth are an essential component of the general welfare of ______________________ Township by maintaining play areas for children and natural beauty, recreation, and an unreplaceable heritage for existing and future Township residents.

Section 2. Therefore, the purposes of this ordinance are:

(a) To provide for the protection, preservation, proper maintenance and use of trees and woodlands located in this Township in order to minimize disturbance to them and to prevent damage from erosion and siltation, a loss of wildlife and vegetation, and/or from the destruction of the natural habitat;

(b) To protect the woodlands (including trees and other forms of vegetation) of this Township for their economic support of local property values when allowed to remain uncleared and/or unharvested and for their natural beauty, wilderness character, or geological, ecological, or historical significance;

(c) To provide for the paramount public concern for these natural resources in the interest of health, safety and general welfare of the residents of this Township;

ARTICLE III - GENERAL PROVISIONS

Section 1. Lands to Which Ordinance Applies. This ordinance shall apply to all lands within the jurisdiction of ______________________ Township upon which any of the following conditions exist:

(a) All lands of which there are (on the effective date of this ordinance) or in the future there shall be found growing trees, shrubs, or similar woody vegetation with a trunk diameter of three (3) inches or more;

(b) Other lands with smaller forms of woody growth which are subject to the permit regulations of the Flood Plain and Wetlands Protection Ordinance of this Township.

Section 2. Construction of Language, Interpretation, and Abrogation.

(a) Rules of Construction. The following rules of construction apply to the text of this Ordinance.

1. In case of a difference of meaning or implication between the text of this Ordinance and any caption or illustration, the text shall control.

2. Particulars provided by way of illustration or enumeration shall not control general language.

3. Ambiguities, if any, shall be construed liberally in favor of protecting the resources indicated in Article two (2).

4. Words used in the present tense shall include the future; and words used in the singular number shall include the plural and the plural the singular, unless the context clearly indicates the contrary.

5. Terms not specifically defined in this Ordinance shall have the meaning customarily assigned to them.

(b) Abrogation and Conflict of Authority. Nothing in this Ordinance shall be interpreted to conflict with present or future state statutes in the same subject matter; conflicting provisions of this Ordinance shall be abrogated to, but only to, the extent of the conflict. Moreover, the provisions of this Ordinance shall be construed, if possible, to be consistent with and in addition to relevant state regulations and statutes.

In their interpretation and application, the provisions of this ordinance shall be held to be minimum requirements and shall be liberally construed in favor of the governing body and shall not be deemed a limitation or repeal of any other powers granted by State statutes.

It is not intended by this ordinance to repeal, abrogate or impair any existing easements, covenants, or deed restrictions. However, where this ordinance imposes greater restrictions, the provision of this ordinance shall prevail. All other ordinances inconsistent with this ordinance are hereby repealed to the extent of the inconsistency only.

(c) Validity as Applied. The Township Board declares that this Ordinance is essential to the health, safety, economic and general welfare of the people of ____________________ Township and is based upon reasonable standards. However, a person owning lands subject to the provisions of this Ordinance and contesting restrictions imposed on said lands under this Ordinance may upon written request require the Township Board to hold a public hearing on the matter; this remedy shall be in addition to any other available remedy under this Ordinance. At such a hearing the person shall be given a reasonable opportunity to present his case to the Board and to submit his own technical evidence if he so desires. If such evidence clearly convincingly demonstrates that strict enforcement of the restrictions under this ordinance prevent the person from obtaining a reasonable or fair economic return from his property, the Board may grant a variance to permits otherwise required under this ordinance. However, such variances shall be limited by express written conditions which provide maximum protection for the natural resource values enumerated in Article two (2); in the absence of other factors, mere economic hardship which is not unreasonable shall not provide a valid basis for such variances.

Section 3. Severability. If any section, clause, provision or portion of this ordinance is adjudged unconstitutional or invalid by a court of competent jurisdiction, the remainder of this ordinance shall not be affected thereby.

Section 4. Definitions.

The following terms, phrases, words and their derivatives shall have the meaning given herein, unless the context otherwise requires:

(a) Commission means the Planning Commission of ____________________ Township organized under P.A. No. 168 of the Public Acts of 1959.

(b) Remove and removal shall include the cutting of trees and the injury and/or destruction of any form of vegetation, by, whatever method, on any lands subject to this Ordinance under section one (1) of this article.

(c) Person shall include any individual, firm, partnership, association, corporation, company, organization or legal entity of any kind, including governmental agencies conducting operations within the township.

(d) Locate shall mean construct, place, insert or excavate.

(e) Owner shall mean any person who has dominion over, control of, or title to woodlands.

(f) Structure shall mean any assembly of materials above or below the surface of the land or water, including but not limited to houses, buildings, bulkheads, piers, docks, landings, dams, waterway obstructions, towers, utility transmission devices.

(g) Development shall include any lawful land use authorized under the zoning ordinance of this Township.

(h) Material shall include soil, sand, gravel, clay, peat, mud, debris and refuse, or any other material organic or inorganic.

(i) Operations shall include the locating, moving or deposition of any material, or any construction use or activity, or a combination thereof which in any way modifies the conditions on lands subject to this ordinance under section one (1) of this Article as they exist on the effective date hereof.

(j) Woodlands shall include all lands which are subject to this Ordinance under section one (1) of this Article.

Section 5. Compliance. No land shall hereafter be used and no structure shall be located, extended, converted or structurally altered without full compliance with the terms of this ordinance and other applicable regulations which apply to uses within the jurisdiction of this ordinance.

Section 6. Other Regulations.

This Ordinance does not obviate the necessity for the applicant to obtain the assent or permit required by any other agency before proceeding with operations under a permit approved under this Ordinance. Obtaining such other permits as may be required is solely the responsibility of the applicant until such permits have been issued.

ARTICLE IV - WOODLANDS PROTECTION

Section 1. Prohibited Acts.

Except as hereinafter provided in this article, it shall be unlawful for any person without obtaining a written permit therefore from the Township Board to:

(a) Remove or damage (or permit to be removed or damaged) any tree, or similar woody vegetation with a trunk diameter of three (3) inches or more.

(b) Remove or permit to be removed any tree, or similar woody vegetation of a smaller diameter which is growning in this Township on lands subject to and regulated by the ________________________Township Flood Plain and Wetlands Protections Ordinance.

Where a final subdivision plat or final site development plan has been approved by the Township Board, such approval, together with any additional terms and conditions attached thereto, shall constitute a permit under this Ordinance.

Section 2. Standards.

The Commission shall establish specific standards to guide the development of woodlands in this Township, including the spacing of trees, the clearin of shrubs and brush, the density of vegetation growth and preservation per acre, forestry and tree replacement practices. However, since the environmental values, soil characteristics, tree growth, and related natural resource parameters will remain unique for each parcel of land and for each development application - each permit application shall be reviewed on an individual basis. Nonetheless, the following criteria must be considered and balanced with respect to each permit application under this Ordinance:

(1) Residential living units shall blend into the natural setting of the landscape for the enhancement of sound, orderly economic growt and development and for the protection of property values in this Township.

(2) The preservation of woodlands, trees, similar wood vegetation, and related natural resources and values, as more fully described in article two (2), shall take priority over all forms of development particularly industrial and commercial development - when there ar no location alternatives.

(3) The protection and conservation of irreplaceable natural resources from pollution, impairment, or destruction shall remain the paramount factor.

(4) No application shall be denied solely on the basis that some trees are growing on the private or public property under consideration. Other factors which demonstrate a public need for woodland preservation must be stated.

(5) The total acreage of woodlands per capita existing in the Township shall be considered.

(6) Each application shall be reviewed to measure the likelihood that some of the parcels of land in question may be required for recreation and/or other public acquisition purposes in the near future.

(7) The relationship of streets, highways and other transportation corridors to the woodland area shall be considered, along with alternatives for new transportation routes and for the location of the proposed development.

(8) All recommendations by the Commission under this Ordinance shall be consistent with total, comprehensive community planning for thi Township.

(9) The burden of demonstrating (i) that there are no feasible and prudent alternatives to the development proposed in a permit application under this ordinance and (ii) that denial of any requested permit will prevent an owner of property in this Township from securing a reasonable or fair economic return from his property - shall be on the applicant.

Section 3. Exception.

No permit shall be required under this Ordinance for the removal or trimming of dead, diseased, and/or damaged trees or other woody vegetation, provided that the damage resulted from a nonhuman cause and provided further that the removal or trimming is accomplished through the use of standard forestry practices and techniques.

Section 4. Permitted Acts.

The following operations and uses are permitted on lands subject to the provisions of this Ordinance as a matter of right, but remain subject to the permit provisions of section one (1).

(i) Conservation of soil, vegetation, water, fish and wildlife;

(ii) Outdoor recreation: including play and sporting areas, field trails for nature study, hiking and horseback riding, boating trapping, hunting and fishing where otherwise legally permitted and regulated;

(iii) Grazing, farming, gardening and harvesting of crops, and forestry and nursery practices where otherwise legally permitted and regulated;

(iv) Operation and maintenance of existing dams and other water control devices, if in compliance with state statutes;

(v) Driveways and roads where alternative means of access are proven to be impractical.

ARTICLE V - PROCEDURE AND APPLICATION DETAILS

Section 1. Form of Application.

(a) All applicants for a permit to do any of the acts permitted by this Ordinance shall present six copies of the permit application together with other required information and materials to the Commission. Thereafter, procedural matters shall be controlled by section two (2) of this article.

(b) All applications and copies thereof must be accompanied by or include the following information:

(i) Name and address of applicant and of applicant's agent, if any, and whether applicant is owner, lesee, licensee, etc., if applicant is not owner, the written consent of the owner, duly acknowledged, must be attached.

(ii) Amount and type of material proposed to be removed and the proposed type of use or operation.

(iii) Purpose of proposed removal or operation.

(iv) Survey and topographical map of the property upon which such removal, operation or use is proposed, prepared in the manner prescribed in subsection (c) below.

(v) Description of the proposed manner in which material will be removed or deposited, structure installed or use carried out.

(c) The permit application shall be accompanied by a survey and topographical map drawn to a scale of no smaller than one inch equals 30 feet, prepared and certified substantially correct by a registered land surveyor or engineer, and including the information listed below. Whenever the cost of the proposed operation does not exceed ($100.00), the plans and specifications need not be prepared by a licensed practitioner:

(i) Name and address of owner of record of the affected property, and of applicant if other than owner, location and dimensions of all boundary lines, names of owners of record of adjoining properties and of properties directly across any road, graphic scale, north arrow and date.

(ii) Existing contour data for the entire property with a vertical interval of no more than 10 feet, and contour data at an interval of no more than one foot for all areas to be disturbed by the proposed operation, and extending for a distance of at least 50 feet beyond the limits of such areas. Indicated elevations shall be based on an established datum which specify the relationship to sea level.

(iii) Specification of the extent of all areas to be disturbed, the extent to which removal or other operations are proposed, the depth of any excavation or fill, and the angle of response of all slopes of deposited materials and/or sides of channels or excavations resulting from removal operations.

(iv) An area map at a scale of one inch equals 200 feet showing property lines and proposed changes in the location and extent of existing watercourses and wetland areas.

(v) If not otherwise included in subparagraph iii above, the specific number of trees to be cut which have a measured trunk diameter of three (3) inches or more, plus a plan and cost estimate for their replacement.

Section 2. Basic Procedure.

All applications for permits under this Ordinance shall be made to the Commission. After appropriate deliberations, and a public hearing if one is requested in writing by the applicant, the Commission shall make a recommendation to the Township Board to approve, deny, or approve with conditions, the requested permit. Within a reasonable time thereafter, at a regular business meeting, the Township Board shall grant or deny the permit or shall grant the permit subject to specific written conditions. Specific written reasons for a denial shall be provided to the applicant. All decisions of the Board may be reviewed by an appropriate circuit court.

Section 3. Permit Conditions and Fee.

(a) The commission may make a part of such permit any conditions it may deem advisable to implement the purposes of this Ordinance. For the permit to remain in force, any removal or operation must be maintained (and all work must be done) so as to comply with the conditions and specifications of the permit.

(b) Every application for a permit shall be accompanied by a non-refundable application fee of fifty dollars ($50.00).

Section 4. Scope of Permits.

All removals, uses and operations permitted or approved by such permits shall be conducted in such a manner as will cause the least possible damage and encroachment or interference with natural resources and natural values and processes described in article two (2).

The Township Board shall upon the adoption of a resolution directing the issuance of a permit:

(a) Impose such conditions on the manner and extent of the proposed removal, operation, use or activity as are necessary to ensure that the intent of this Ordinance is carried out;

(b) Fix a reasonable time within which any removal or operation must be completed:

(c) Require the filling with the Township of a cash or surety performance bond, in such form and amount as determined necessary by the Commission to ensure compliance with the approved permit.

Section 5. Property Inspection.

(a) All removal and other operations conducted under permits granted under this Ordinance shall be open to inspection at any time by any agency or agent of the Township or State.

(b) The Commission, its agents, surveyors, or other employees may make reasonable entry upon any lands within the Township for the purpose of making any investigation, survey, or study contemplated by this Ordinance. An investigation of woodland areas may be made by the Commission on its own initiative and shall be made upon written request of any three titleholders of land abutting lands covered by section one (1) of article three (3).

(c) The permit applicant or his agent proceeding with approved removals or operations shall carry on his person or have readily available the approved permit and show same to any agency or agent of the Township or state whenever requested.

ARTICLE VI - PENALTIES AND ENFORCEMENT

(a) Any person found guilty of violating any of the provisions of this ordinance shall be punished by a fine not to exceed $100.00 or imprisonment not to exceed 90 days, or by both such fine and imprisonment in the discretion of the court. The Commission, in addition to other remedies, may institute any appropriate action or proceeding to prevent, abate or restrain the violation. Each day's continuance of a violation shall be deemed a separate and distinct offense.

(b) The grant or denial of a permit shall not have any effect on any remedy of any person at law or in equity; Provided, that where it is shown that there is a wrongful failure to comply with this ordinance, there shall be a rebuttal presumption that the violation was the proximate cause of the injury to the land of any person bringing suit.

(c) Any person violating the provisions of this Ordinance shall become liable to the Township for any expense or loss or damage occasioned by the Township by reason of such violation. This shall include without limitation by reason of enumeration attorney fees and the cost of replacement of removed trees and other woody vegetation.

ARTICLE VII - JUDICALLY INVALIDATED PERMITS

Any decision regarding a permit application under this Ordinance shall be judically reviewable. In the event that, based upon the proceedings and decision of an appropriate court of the State, a taking is declared, the Township may within the time specified by such court, elect to:

(a) Institute condemnation proceedings to acquire the applicant's land in fee by purchase at fair market value; or

(b) Approve a permit application with lesser restrictions or conditions.

ARTICLE VIII - EFFECTIVE DATE

This Ordinance shall take effective immediately.

SECTION VIII

HILLSIDES

A. Introduction

In comparison to the regulation of other sensitive areas, the history of hillside development regulation is quite extensive. Consequently, hillside regulations are quite sophisticated in their ability to match the resource capabilities of hillsides with the requirements of development. A major reason for this high level of regulatory sophistication is the series of disasters resulting from poorly designed hillside development. As with floodplain regulations, the willingness to develop land-use regulations for sensitive areas seems tied to the frequency or magnitude of "natural" disasters. However, there is nothing "natural" about hillside disasters which damage homes, degrade water supplies, or increase flood hazards. In almost every case such disasters are the result of insufficient predevelopment investigation, poordevelopment design, or inappropriate construction practices.

The experience of the Los Angeles area is a case in point of the relationship between hazard conditions and preventative regulation of hillsides development. In the early 1950s, as a result of the decreasing availability of flat land open to development within the metropolitan area, development pressures on the hillsides of the city and county increased. In these early years, hillside development generally followed standard flat-land practices. Instead of developing the hillsides in a manner compatible with hillside geology, the hillsides were simply flattened by cut-and-fill construction. As millions and millions of cubic yards of earth were moved from one place to another, little notice was given to underlying geology, drainage patterns, or soil conditions. And the hillsides that were left were developed as if they were flat rather than sloping land.

With the advent of each wet season, it became apparent that there was something seriously wrong with these developmental and regulatory practices. Various parts of the city and county experienced severe problems with erosion, land subsidence and settlement, and landslides. In the 50s' the resulting damages totaled several millions of dollars.

By 1953 both the city and county of Los Angeles recognized that something was wrong and began experimenting with various regulations designed to improve previous developmental practices. By 1963 a series of regulations had been developed and were being applied on a broad and relatively consistent scale. They included grading regulations, density restrictions, and a newly defined role for engineering-geologists in the regulatory process. By the end of 1963, the city and county had developed a set of regulations which would minimize future damage in hillside areas.

These regulations were put to the test in early 1969. The months of January-February 1969 marked the heaviest rainfall in Los Angeles County in over 85 years. Of the 11,000 hillside sites developed since the new regulations went into effect in 1963, damage was limited to a total of $182,000. In the same storm, damage to sites developed previous to 1963 amounted to more than 6.3 million dollars. On a per-unit basis, sites developed under the post-1963 regulations experienced an average damage of $16, or 1/10 of the average $160 damage for each site developed previous to 1963. Clearly, the regulatory process was effective.[1]

The success of the new regulations in Los Angeles is appropriately measured in dollars. Poorly designed and constructed hillside developments frequently result in substantial costs to the public, either for repairs or for protective measures to prevent further damage. Increased runoff and sedimentation from denuded hillsides requires increased public expenditures for flood control and storm water management. If these costs were absorbed in specialized onsite design regulations, then the general public would be spared the additional expense. However, once the basic development pattern for an area is established, the public must either provide protection or live with the threat of disaster. In either case it is an expensive undertaking as was recently discovered by the citizens of Orange County, California, where poorly regulated hillside development was partially responsible for a 500 million dollar remedial flood-protection program. And in Seattle a local agency recently spent several millions to shore up hillsides which threatened both the lowlands and development on the slope itself.

Not only does poorly regulated hillside development result in increased public expenditures for remedial protection from disaster, additional dollars must be spent for various public utilities and public services in such areas. Development in hillsides is more expensive than development in flatter terrain. Sewer lines and water lines in hilly areas require special engineering and sometimes specialized equipment. Roads need the same specialized engineering and construction practices. Similar specialized attention must be given to public structures, such as schools, fire stations, and police stations. These expenditures amount to public subsidies for the benefit of hillside residents at the expense of citizens living in more accessible terrain.[2]

Since the stability of each hillside depends upon the unique combination of vegetation, climate, soil, and underlying geology, which varies from region to region, problems of hillside development also vary. In the Southwest, erosion of hillsides is a severe problem, especially in Arizona where sparsely vegetated hillsides raise concern for the scarring of steeply sloping areas. Erosion of New Jersey, Maryland, and Virginia hillsites creates special problems for siltation in downstream areas. Landslides are a major problem along the Pacific Coast, particularly around San Francisco and Los Angeles, and in the Pacific Northwest. Pennsylvania and West Virginia's local concern focuses on the occurrence of abandoned mine shafts which underlie some hillsides.

Because of the variety of local concern and approaches to hillside development, regulations must be tailored to each specific case, thus requiring the collection of data and the implementation of various techniques in each area. Consequently, it is impossible to specify the "best" approach to hillside regulation since local circumstances vary so widely. In the following material we identify those environmental factors which resulted in the varied regulatory approaches and discuss the necessary information or expertise required to implement any single approach.

B. Hillsides and the Public Response

Hillsides are a different kind of critical area. Unlike groundwater, they are not a renewable resource, nor do they, like woodlands or wetlands, have clearly defined benefits for the public good. Hillsides are geological features on the landscape whose slope and soils are in a balance with vegetation, underlying geology and the amount of precipitation. Our major interest in hillsides is to maintain this equilibrium. Since we are more interested in the potential damage from hillsides to public health and safety than in their positive contributions, the major way hillsides serve the public interest is by staying where they are.

Development of hillsides affects the equilibrium of vegetation, geology, slope, soil, and precipitation to one degree or another, and the public objectives can be defined in terms of that disturbance:

1. Disturbance of hillsides can result in the loss of slope and soil stability as well as increased erosion. The removal of vegetation from hillsides deprives the soil of the stabilizing function of roots, as well as the moderating effects on wind and water erosion of leaves and branches. Loss of soil stability increases erosion and thus decreases downstream water quality as a result of siltation. Downstream wetlands can be injured in this way. Spring thaws or strong rains on unstable slopes can produce mass movements, such as landslides, slumps, and flaws, particularly in steeply sloping areas.

2. Disturbance of hillsides can increase runoff. Development may alter the natural drainage pattern of a hillside, producing increased runoff and erosion. Removal of vegetative cover decreases percolation of precipi-

tation into the soil,thereby reducing the amount of groundwater recharge and adding water to runoff that would ordinarily be transpired by trees and shrubs. Construction of impervious surfaces,such as roads and buildings,decreases the amount of groundwater percolation and thus increases the amount of runoff. Increased runoff, in addition to producing intensified erosion, also creates downstream flood hazards.

3. Disturbance of hillsides can destroy a community's aesthetic resources. A range of hills frequently marks a community's boundaries in sloping areas, as well as provides an attractive setting for homes and buildings. Degradation of hillsides as result of erosion, mass movement, loss of vegetation, and damage to downstream areas deprives a community of its attractive and distinctive setting and decreases real estate values.

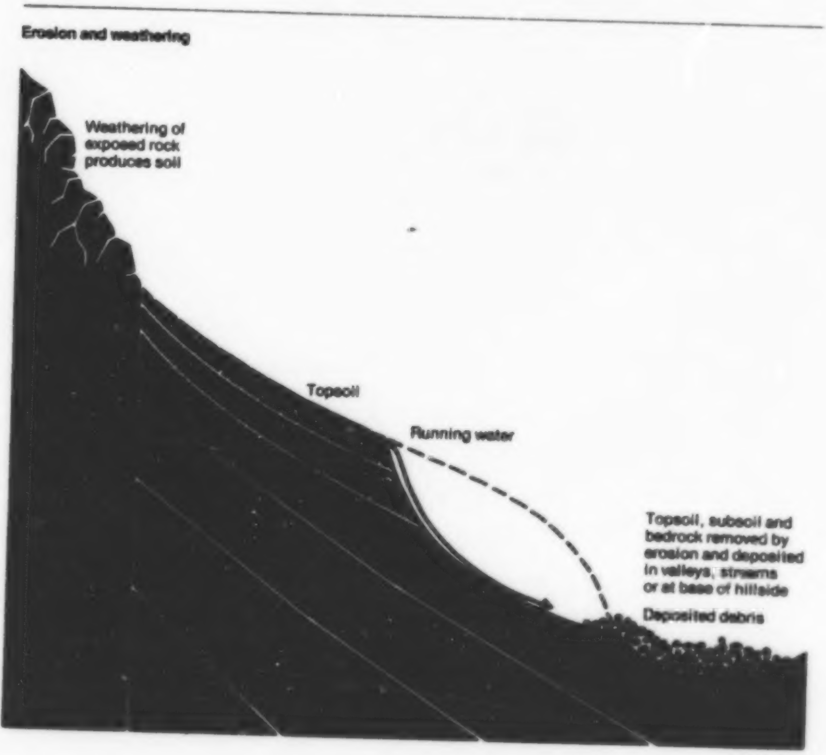
In these three areas, hillside development can have a far-reaching impact upon a community's land, water, economic, and aesthetic resources. Yet hillsides can be developed in a manner compatible with hillside ecology. What are the natural constraints we must consider in regulating hillside development?

1. Mass Movement and Erosion

Though the slope and soil of a hillside are generally balanced with the amount of precipitation, vegetative cover, and the underlying geology, hillsides are constantly in motion. Most typically this perpetual downward movement of hills is the result of the almost imperceptible and gradual effects of weathering and erosion. Alternate freezing and thawing of rocks and the chemical action of water gradually disintegrates them into soil particles. The downward pull of gravity, aided by the force of running water or frozen water, moves these materials down the slopes. These types of hillside movement are part of the hydro-geologic cycle which creates new soil by weathering and, through the transporting power of streams, carries it into valleys and plains. (See Figure VIII-1.)

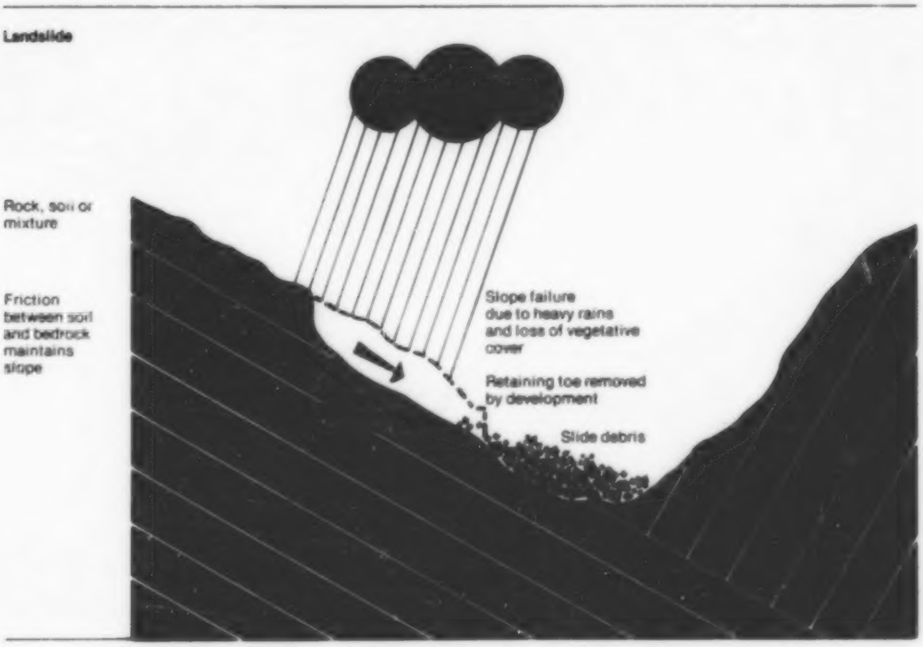
We are only concerned with hillside movement when rocks and soils are transported at a rapid rate or in large quantities as a result of landslides, slumps, mudflows, and other forms of mass movement or as a result of rapid erosion. Rock formations and soils are held in place by friction. Thus, any increase in the load can cause a landslide. Since water between

Figure VIII-1


Erosion and weathering
Weathering of exposed rock produces soil
Topsoil
Running water
Topsoil, subsoil and bedrock removed by erosion and deposited in valleys, streams or at base of hillside
Deposited debris

the rocks and particles acts as a lubricant, rocks and soils heavily saturated by spring thaws or periods of intense precipitation can overcome this friction and cause a slide. Moreover, since saturated materials are heavier than drier ones, heavy rains or melting water can overload a slope's retaining capacity. Earthquakes may also disturb the friction between rock and soil particles and cause a slide. In addition to the retaining power of friction, many slopes are held in place by accumulated debris or other formations at the bottom or foot of the hill. Loss of this support through erosion or development can also cause a landslide. (See Figure VIII-2.)

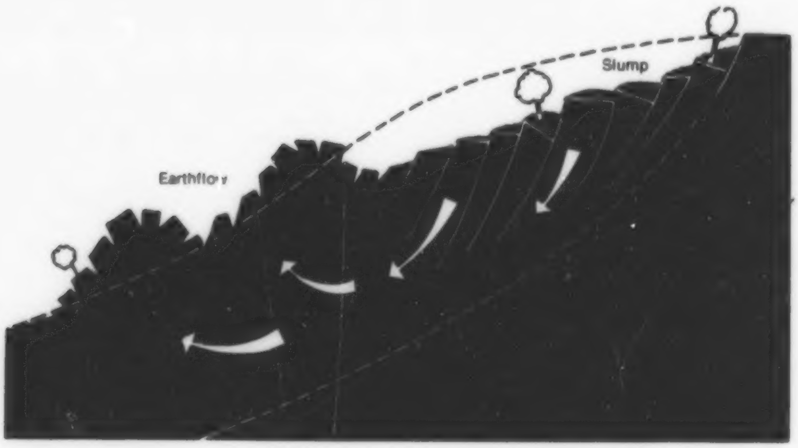
Figure VIII-2[3]


Landslide
Rock, soil or mixture
Friction between soil and bedrock maintains slope
Slope failure due to heavy rains and loss of vegetative cover
Retaining toe removed by development
Slide debris

Slumps and mudflows, though less dramatic than landslides, are other forms of mass movement. Both of them result when the soil is oversaturated, thereby decreasing the friction between the particles. Slumps occur in homogeneous materials, such as clay soils, and are frequently seen along highway grades where the collapsed materials bulge at the base of the slump. (See Figure VIII-3.) Mudflows occur in saturated heterogeneous materials, such as gravels and silt, and are common in arid regions during heavy rains.

Figure VIII-3[4]

Cross section of a slope undergoing slump



Disturbance of hillsides susceptible to the mass movement of materials in landslides, slumps, and mudflows usually occurs in two ways: decreasing stability and increasing ground water load.

Vegetation not only aids slope stability with roots, but also consumes a great deal of water; thus removal of grasses, shrubs, and trees can increase soil saturation by the release of more water for absorption by the soil. Even in those circumstances when it is possible to replace natural vegetation with artificial landscaping, there can be severe consequences. It is estimated that one of the chief causes of slope failures in the Los Angeles area was the replacement of natural vegetation with lawns and various exotic shrubbery. In contrast to the natural vegetation, the suburban landscape required extensive quantities of water to support its growth. Increases in the amount of water found their way to subsurface geology and reduced the friction between a layer of clay and bedrock. With reduced friction, the slope failed.

Even in vegetated areas the degree of moisture in the soil, particularly during seasonal rainfall or melt, may be too much to allow for any development, which would increase the water content and create slide, slump, or flaw hazards. A good index for such areas is the average height of the water table. If it is near the surface, development should be prohibited, not only because of potential mass movement, but also because of the likelihood of polluting groundwater resources.

The mechanical alteration of the arrangement of rocks, soils, and the particles making up the slope also increases the possibility of mass movement. Though grading and road construction on the slope or the disturbance of the retaining formation at the base of a hill may not cause mass movement, these activities can make the slope more susceptible to slides, slumps, and flows. Particular care should be taken in the West and

Southwest and other areas of frequent seismic activity, of periodically heavy rains, or rapid melting of accumulated heavy snowfall.[5]

These dramatic mass movements of slopes in slides, slumps, and flows are less frequent agents of hillside movement than the slower, less catastrophic action of erosion. Erosion is a function of the degree of slope, soil type and condition, and vegetative cover. The greater the degree of slope, the more susceptible the hillside to erosion. To a lesser extent, the erosion rate is also dependent upon the length of slope.

Steeply sloping areas are particularly vulnerable to erosion, and certain soils are more susceptible to erosion than others. In general, the less permeable or capable of absorbing and retaining water a soil is, the more liable it is to erosion from running water. Thus clays and other soils which do not absorb water are more easily eroded than sands or gravels, which absorb precipitation.

Vegetative cover plays an important role in moderating erosion. Leaves and organic litter cushion the impact of precipitation as well as increase the permeability of a soil. Hillside development can deprive a slope of its protective cover of grasses, shrubs, and trees, and while dried hay may be scattered over a disturbed slope or vegetation may be replaced, some soils will support only specialized vegetation. In arid areas and in regions where the soil mantle is very thin, even a short period of no cover, especially during periods of heavy precipitation or melting, can erode enough of the soil to make replacing lost vegetation difficult, if not impossible. In the red clay hills of northern Mississippi and Georgia loss of vegetative cover results in rapid erosion of scant topsoil, leaving its highly unpermeable clay subject to extensive erosion. Replanting these hillsides has taken decades of experimentation and work.

Rapid erosion of hillsides causes many more problems than the loss of hillside soil. Since the effects of hillside erosion as a result of disturbance are felt throughout the entire drainage basin, what happens on the hillside will eventually be reflected in the larger watershed. The impact of increased runoff may thus be far greater in downstream areas than on the hillside itself. The increased sediment load can choke streams, fill up wetlands, and increase turbidity--the amount of suspended particles in the water of lakes and streams--thereby making these water systems unsuitable for drinking water and for supporting many species of plants and animals.

The mechanical alteration of slopes by grading or levelling not only destroys the vegetative cover, it also alters the character of a slope. The degree of slope may be increased, thereby increasing erosion, and more easily eroded soils or rocks may be uncovered. The most extreme alteration of a hillside is to level it. This and similar radical changes of hillsides can have far-reaching consequences ranging from rapid erosion, disturbance of groundwater hydrology, to alteration in stream flow and drainage patterns.

In altering the slope or foot of a hill or removing vegetation, care must be exercised that as little disturbance as possible is made to the equilibrium of the slope. Areas of periodically heavy rains or melting, with scant soil cover, or frequent seismic activity, or with very steep slopes are particularly vulnerable to disturbance. In these and all other hilly areas as well, particular care must be taken in understanding the hillside geology so that retaining formations are not disturbed or the arrangement of soil and rock is not altered to the point of producing slides, slumps, and flows. Vegetative cover must also be maintained in order to prevent rapid erosion, loss of hillside soils, and damaging siltation of downstream areas.[6]

2. Runoff and Drainage Patterns of Hillsides

A crucial factor in the stabilization of hillsides is the development of a stable drainage system. The combination of degree of slope, soil type, vegetative cover, underlying geology, and precipitation pattern determines the particular form of streams and tributary watercourses, which carry the 35-40 per cent of precipitation that is not retained by the soil or used by plants. On a vegetated, mature hillside the drainage pattern is relatively stable, changing only slowly as gradual erosion alters the slope. Generally,a stable system is rather complex, consisting of many connected watercourses which feed one stream or a few major ones. On slopes with no vegetation and exposed soils, either as the result of fires, massive movement, or human disturbance, the drainage pattern is rather simple, becoming more complex as watercourses erode the divides between them and develop into a few major streams with tributary creeks and rills.

A gullied slope is a familiar and unattractive result of disturbance of a hillside's drainage pattern. Roads and other constructions cutting across streams or the grading and levelling of slopes make runoff water seek new channels. The development of new watercourses and drainage systems increases erosion and the rate of runoff flow, resulting in downstream damage from siltation and flooding.

Usually vegetation is also disturbed by hillside development, causing additional problems from increased runoff. Vegetation moderates runoff in three ways. Grass, shrubs, and trees not only stabilize soils and moderate erosion, they also absorb large quantities of precipitation which is transpired by their leaves into the atmosphere. In cold areas, trees--especially evergreens--shade accumulated snowfall, allowing it to melt gradually. Vegetative litter and roots retain and slow the flow of runoff, as well as aid in the percolation of precipitation into groundwater reserves. Thus loss,of vegetation increases runoff by releasing precipitation that would either be used by plants or absorbed and retained by their roots and litter.

Increasing impervious surfaces on hillsides is one of the more frequent ways in which hillside drainage are altered by development. Roads may cut across stream channels, disturbing the drainage pattern, and they, along with buildings and parking lots, decrease the amount of water retained by the soil, thereby increasing runoff. Not only is runoff and its associated problem of downstream siltation and flooding increased, but less precipitation is able to enter groundwater reserves.

Hillside development must proceed with firm understanding of drainage systems. Not only must a stable drainage pattern be maintained, but vegetative cover must be preserved in order to prevent rapid runoff and erosion, downstream siltation and flooding and loss of groundwater recharge.

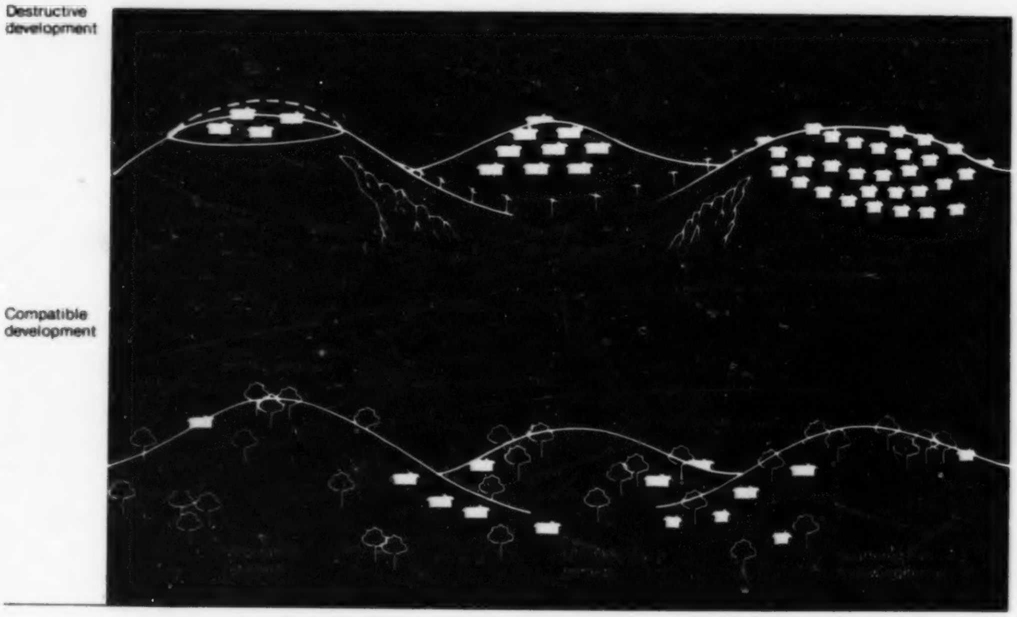
3. Hillsides are Aesthetic Resources

Hillsides are distinctive features of a local landscape, providing a community with an attractive setting. Often they are natural boundaries which establish the political identity of the local unit of government. For instance, communities such as Berkeley, Walnut Creek, and Richmond are sprinkled in the valleys among the many hills in the San Francisco Bay area. Hillsides also provide attractive vistas of a region, as well as opportunity for recreational activities in the woods on their slopes. One index of the aesthetic value of hillsides is the premium of real estate sites with "a view." But it is relatively difficult to quantify the aesthetic resources of a hillside in providing a varied landscape and community identity.

A comparison of the illustrations in figure 4 suggests the ways in which, on the one hand, the aesthetic resources of hillsides may be destroyed by some forms of land use and, on the other, they may be preserved. Long lines of nearly identical housing units ring the hills of Daly City, California, and large segments of hills have been removed in Tucson, Arizona, leaving flat-topped hills and filled-in lowlands. Other communities where erosion of the scant soil cover is rapid, such as Phoenix, Arizona, have permanently scarred their hillsides. Of course these and other developments of hillsides are not only unattractive but also destructive to the stability of hillside geology and drainage. Scattered projects which retain most of the vegetation and distinctive features, such as hilltops and outcroppings, and follow the natural terrain are not only attractive, but also safe and ecologically sound ways of developing hillsides.

Figure VIII-4

Destructive and compatible hillside development



C. Current Practice in Hillside Regulation

1. The Intent of Regulation

Most land-use regulations begin with a statement of purpose or intent. The function of this statement is simply to identify the public purpose served by the regulation. In the previous section, several important public values in hillside regulation were identified, including protection from mass movement and erosion, excess runoff and siltation, and preservation of aesthetic resources. In developing local regulations it is desirable to spell these values out rather than relying upon vague generalizations such as "preserving our hillsides" or "maintaining our unique local environment." The closer local regulations are tied to specific health, safety, and welfare concerns, the more solid the legal defense of the regulation will be.

The following statements of purpose are taken from two local ordinances which establish and regulate the development of special hillside districts. These statements specify the community's particular social, economic, environmental, or aesthetic objectives in creating such regulations. Each of these objectives is then reflected in the actual standards and regulatory processes defined in the remainder of the ordinance or act.

Pacifica, California

It shall be the purpose of the Hillside Preservation District to promote the following City objectives which shall be considered as guidelines:

(a) To maximize choice in types of environment available in the City and particularly to encourage variety in the development pattern of the hillsides;

(b) The concentration of dwellings and other structures by clustering and/or high-rise should be encouraged to help save larger areas of open space and preserve the natural terrain;

(c) To use to the fullest current understanding of good civic design, landscape architecture, architecture, and civil engineering to preserve, enhance, and promote the existing and future appearance and resources of hillside areas;

(d) To provide density and land-use incentives to aid in ensuring the best possible development of the City's natural features, open space, and other landmarks;

(e) To encourage the planning, design, and development of building sites in such a fashion as to provide the maximum in safety and human enjoyment while adapting development to, and taking advantage of, the best use of the natural terrain;

(f) To preserve and enhance the beauty of the landscape by encouraging the maximum retention of natural topographic features, such as drainage swales, streams, slopes, ridge lines, rock outcroppings, vistas, natural plant formations, and trees;

(g) To prohibit, insofar as is feasible and reasonable, padding or terracing of building sites in the hillside areas;

(h) To provide a safe means of ingress and egress for vehicular and pedestrian traffic to and within hillside areas, while at the same time minimizing the scarring effects of hillside street construction;

(i) Utility wires and television lines shall be installed underground;

(j) Outstanding natural physical features, such as the highest crest of a hill, natural rock-out-croppings, major tree belts, etc., should be preserved;

(k) Roads should follow natural topography wherever possible, to minimize cutting and grading;

(l) Imaginative and innovative building techniques should be encouraged to create buildings suited to natural hillside surroundings; and;

(m) Detailed and effective arrangements shall be formulated for the preservation, maintenance, and control of open space and recreational lands resulting from planned unit development.

Obviously, Pacifica's statement of purpose is quite inclusive. Since the objectives covers a whole range of local concerns, this statement is a solid introduction to the regulation.

Walnut Creek, California

It is therefore the intent of the City that undeveloped land in hillside areas be placed in a Hillside Planned Development District, to be identified by the initials H-P-D, in order to accomplish the following:

(a) To preserve significant features of a hill area in essentially their natural state as part of a comprehensive open space system;

(b) To encourage in hill areas as an alternative approach to conventional flatland practices of development;

> (c) To minimize grading and cut-and-fill operations consistent with the retention of the natural character of hill areas;
>
> (d) To minimize the water-runoff and soil-erosion problems incurred in adjustment of the terrain to meet onsite and offsite development needs;
>
> (e) To achieve land-use densities that are in keeping with the general plan; however, in order to retain the significant natural features of the hill areas, densities will diminish as the slope of the terrain increases;
>
> (f) To insure that the open space as shown on any development plan is consistent with the open-space element shown on the General Plan; and areas and to retain the sense of identity and imageability that these hill areas now impart to the City of Walnut Creek and its environs. (Sec. 1, Ord. 1146, eff. September 13, 1972.)

The Walnut Creek example narrows the purposes of the ordinance. While not as complete as Pacifica, it is nevertheless a good statement of purpose.

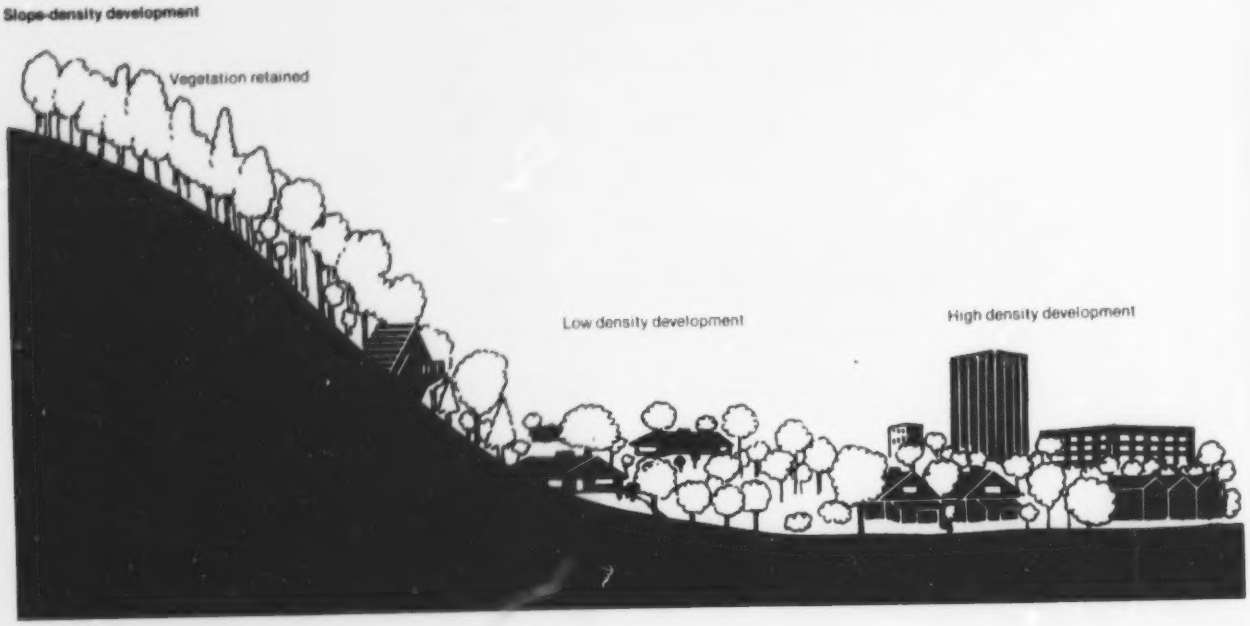
The statement of purpose or intent summarizes the specific objectives of the local community in regulating hillside development. While the emphasis of this report focuses on environmental concerns, it is important to note that a statement of purpose should include the various social and economic objectives which also apply. The statement of purpose or intent is the basic foundation for the remainder of the regulation.

2. Key Features of the Regulatory Approach

There are three principal approaches to the regulation of hillside development: 1) slope-density provisions, which decrease allowable development densities as slope increases; 2) soils-overlay provisions, which assign use and density on the basis of soil characteristics in sloped areas; 3) the guiding principles approach, which is relatively free of precise standards but which emphasizes case-by-case evaluation on the basis of a number of specific policies. Grading and erosion controls are important supplements to these three techniques.

a. Slope-Density Provisions--Slope-density provisions are assuming an increasingly larger role in the regulation of hillside development. These provisions, which state what degree of density may be built on a particular slope, are becoming a primary means of hillside protection. Their purpose is to define the percentage of a particular parcel of land which can be developed on the basis of that parcel's average slope. The greater the slope, less of the parcel may be developed. The lesser the slope, more of the parcel may be developed. (See Figure VIII-5.)

Figure VIII-5



The basic environmental rationale supporting the slope-density approach is simple. Other factors being equal, as slope increases so does the potential for environmental degradation. This includes, for example, the probability of slope failure, increased erosion, sedimentation, and runoff. Limiting development according to the degree of slope encourages development into areas which have the least potential for environmental damage while protecting steeper, more sensitive land from development pressures.

Slope-density provisions achieve several of the typical local objectives spelled out in the purpose or intent of regulation. In lowering densities as a function of slope, the potential for environmental degradation is decreased. Economic costs to the community in terms of public safety and other public services are reduced when steep slopes are more restricted. Aesthetic values are maintained if development is encouraged in gently sloping areas and steeply sloped, dominant landscapes are maintained in their natural state. In these and other ways, slope-density provisions make good environmental sense.

Another attractive feature of slope-density provisions is the substantial flexibility in setting the exact standards. These standards as we shall see, are easily adapted to reflect specific local concerns. In a community composed entirely of sloped areas, the standards may be far less restrictive than in a community intent on maintaining the natural quality of a few dominant sloping areas. In a community with a history of steep-slope failures or with extensive erosion problems, a very restrictive slope-density provision makes good sense. Each jurisdiction utilizes the same basic concept, but each is able to adjust the provision to meet specific local needs. For example, in Pacifica and Thousand Oaks, California, all lands at or exceeding an average slope of 35 per cent must be retained in their natural state. However, in Weber County, Utah, lands with an average slope of 35 per cent or greater may be developed with lot sizes ranging from 10,000 to 75,000 square feet.

Still, there are a variety of shortcomings to this approach. While one can state that, in general, the potential for degradation increases as a function of slope, in some instances may be more a problem on relatively gentle slopes than on steeper ones. Erosion may be more a function of vegetative cover and soil type than degree of slope. In other cases runoff in gently sloping areas may exceed that of steep-slope areas. Though many other factors affect the potential for hillside damage, the main strength of slope-density provisions is in the recognition of the fundamental relationship between slope and the potential for degradation. Since they are a useful device in the absence of a great deal of site-specific information, they are particularly appropriate for local communities with limited technical resources. When combined with more exacting site-specific informational requirements, they can be both flexible for developers and dependable for local communities in maintaining critical environmental values.

Another shortcoming of slope-density provisions is the method by which average slope is determined. One corner of a parcel may be steeply sloping and fall under highly restrictive regulations. However, the rest of the parcel may be gently sloping and the average slope may thus be low enough to allow development of the entire area. Regulations meet this problem of how to determine average slope by specifying that any slope above a certain percentage cannot be developed and thus must be excluded from the average slope equation. Thus in communities such as Pacifica, California, all slopes over 35% are protected, regardless of what portion of a parcel contains such steep areas.

There are three principal variations on the slope-density approach: slope-lot size, slope-natural area, and slope-dwelling units. With slope-lot size, minimum lot size increases with average slope. With slope-natural area, the amount of land to be left in its natural state increases with slope. On the basis of slope-dwelling unit, the number of permissible dwelling units falls as slope increases. In some local jurisdictions, each of these variations is contained in the ordinance. In others, two of the three are used. Commonly, however, only one is chosen.

1. Slope-lot size--the earliest slope-density provisions grew out of efforts to define a relationship between average slope and required minimum lot size. Marin County, California, may have been the first to define such a relationship in the late 1950s. Since that time, a number of local jurisdictions have chosen this basic route. Table VIII-1 compares the slope-lot size requirements of three jurisdictions. From this table it should be apparent that local conditions play a key role in determining minimum lot size in relation to average slope. In Santa Fe, New Mexico, hillsides are particularly vulnerable to erosion. In Phoenix, Arizona, hillsides are easily scarred. In Orange County, California, erosion, scarring, and slope failure are all questions of local concern.

Table VIII-1. SLOPE-LOT SIZE REQUIREMENTS

Percent Average Slope	Santa Fe, N.M.*	Phoenix, Az.	Orange Co., Ca.*
5	.25 Acres	No Req.	No Req.
10	.50 Acres	.55 Acres	No Req.
15	1 Acre	.90 Acres	No Req.
20	2 Acres	1.30 Acres	.16 Acres
25	5 Acres	2.00 Acres	.22 Acres
30	No Develop.	3.33 Acres	.44 Acres
35+	No Develop.	5.00 Acres	1.00 Acres
40	No Develop.	5.00 Acres	5.00 Acres
50+	No Develop.	5.00 Acres	10.00 Acres

*Proposed Regulation

Along with regulating lot sizes according to slope, local jurisdictions must also be careful to include coverage requirements. The amount of land which is covered by impervious surface is an important variable in the determination of developmental effects on hillside. Runoff, for example, is directly related to impervious surface as well as slope. When a slope is covered with impervious surface, runoff increases dramatically, thereby increasing the potential for erosion of the hillside in addition to siltation of the down-watershed area.

One effective regulatory response to the hazards of impervious surface is found in coverage maximums, which specify the amount of land that may be covered by impervious surface. For example, in the proposed Santa Fe, New Mexico, regulation, lot sizes of up to one acre are restricted to a maximum of 30 per cent lot coverage for structures. At two acres and above, this maximum drops to 10 per cent lot coverage for structures. In the proposed Orange County ordinance, coverage maximums are also a function of lot size: the smaller the lot size (7,000 sq. ft.) the higher the allowable coverage (40 per cent); the larger the lot size (10 acres), the lower the allowable coverage (5 per cent).

In steep-slope areas, such as Orange County, large lot sizes may be required. Orange County proposes a 10-acre minimum on slopes greater than 50 per cent, allowing a maximum land coverage of 5 per cent. For a 10-acre lot, then Orange County proposes to set the coverage maximum at one-half acre in the steepest slope area. In contrast, a less rugged area of 20 per cent average slope allows a coverage maximum of 40 per cent on a 7,000 square foot minimum lot, amounting to some 2,800 square feet of coverage. Coverage maximums in this case provide effective support to the environmental rationale of the basic slope-density relation. The concept is simple. If, for example, a land area of some 100 acres were classified in the 50 per cent average slope category, the Orange County proposal would establish up to 10 dwelling units with a maximum impervious surface of 5 acres. If these same 100 acres were classified in the average slope of 20 per cent, some 625 dwelling units would be allowed which would cover a total of 40 acres in impervious surface. At a lower average slope, both density and coverage could increase, while at higher average slopes density and coverage would decrease. In the design of minimum lot size-slope relationships, this is an important concept. Liberal coverage allowances in steep-slope areas can reduce the environmental effectiveness of the ordinance.

2. Slope-natural state--some jurisdictions are facing the question of coverage more directly. The slope-density relation specifies some percentage of the site which is to be retained in a natural or undisturbed state. On the land so specified, only uses which do not require topographical change or major construction such as conservation or recreation are allowed. Table VIII-2 presents a comparison of three jurisdictions which specify the per cent of each site to be retained in a natural state as a function of average slope.

Once again, there is some variation in the local application of the "natural-state" provision. In most categories, Thousand Oaks, California, requires a larger percentage of the site to be retained in a "natural state." Chula Vista, California, requires less a percentage than the others in the low-slope categories, but more than both at the average slope of 30 per cent. The variations are another reflection of the rule of local conditions.

Table VIII-2. Slope-Natural State Requirements

Percent Average Slope	Chula Vista, Ca.	Pacifica, Ca.	Thousand Oaks, Ca.
10	13.75	32	32.5
15	31.25	36	40.0
20	43.75	45	55.0
25	62.50	57	70.0
30	90.00	72	85.0
35	90.00	90	100.0
40	90.00	100	100.0

3. Slope-dwelling units--the final variation of the slope-density provision is found in the specification of the number of dwelling units allowable according to the degree of slope. This is commonly accompanied by provisions which establish minimum lot size as a function of slope or which establish the per cent of the site to be retained in "natural-state" according to slope. Table VIII-3 identifies its application in three jurisdictions.

Table VIII-3. Slope-Dwelling Units Requirements

Percent Average Slope	Walnut Creek, Ca.	Phoenix, Az.	Thousand Oaks, Ca.
5	No Req.	No Req.	No Req.
10	3.5	1.8	2.0
15	3.0	1.1	11.6
20	2.5	.7	1.2
25	2.0	.5	.8
30	1.5	.3	.4
35	1.0	.2	.1
40	.5	.2	.1

Once again, the relationship between average slope and dwelling units per acre can be seen to reflect varying local needs. In most categories, Phoenix is the most restrictive, with Walnut Creek the most permissive. Yet in the higher average slope categories, it is Thousand Oaks which places the maximum restraints.

The use of the basic slope-density equation has grown from the determination of minimum lot size and buildings per acre to the determination of the area which must be retained in a natural state. In one community, Chula Vista, California, it has also extended into the identification of the maximum area which may be graded as a function of slope. (See p. 375 for grading provisions.)

In all cases, it retains the dominant environmental rationale of protecting the natural functions of hillsides. This protection occurs under the basic principle that steep-slope areas are more sensitive than areas of lesser slope.

Slope-density is also flexible. As should be apparent from the foregoing tables, the exact specifications tied to average slope can be quite varied. Highly erodible or easily scarred slopes may require lower densities than slopes which are less erodible or less easily scarred. Slide-sensitive slopes may preclude the placement of structures altogether. Thus slope-density requirements are adaptable to local needs.

b. Soil Overlays--a second approach to the regulation of hillside development is through the use of soil overlay maps. The overlays themselves are usually developed by the Soil Conservation Service in cooperation with local agencies on a cost sharing basis. A soil overlay map identifies soils in particular areas which make them suitable or unsuitable for particular types of development. The use of overlays places an exacting dimension on one important variable in hillside areas. With the more precise knowledge generated by such soils surveys, local communities are able to fine-tune their regulatory approach. Those sloped areas which present special environmental problems can be identified and dealt with while those areas with relatively few constraints can be treated in a more lenient fashion.

McHenry County, Illinois, has developed "Soils Overlay Regulations," which are applied in addition to the requirements of the primary zoning districts. Under this overlay regulation, a special "Steep Soils Overlay District" has been established based on a special series of soil types which have slopes greater than 12 per cent. Since these soils are particularly vulnerable to erosion and problems of sewage disposal, the district places additional restrictions on any primary use. If the primary use is residential, the regulations specify certain procedural requirements for any "onsite sewage disposal, sewage lagoons, oxidation ponds, landfills, or extensive site modification. . . ."

The small town of Mine Hill in Morris County, New Jersey, is using a soil survey to regulate development in sensitive slope areas. The limitations of certain soils are based on an analysis of the Morris County Soil Survey Map. Eight separate soil types on slopes in excess of 15 or 25 per cent are identified as "unbuildable." The ordinance simply states that "Applicants shall not place structures or construct improvements on those lands indicated in Schedule V as unbuildable." Since soil surveys have not been completed for most of the state, New Jersey is perhaps more fortunate than many states. In the case of Mine Hill, a private consultant adopted this environmental information into ordinance form. If such information is available (and relatively current), it is an excellent foundation from which key features of a hillside development regulation may be developed.

The Soil Conservation Service Department of Orange County, New York, cooperated with the Department of Planning to produce a set of regulations based on a variety of soil types also. One interesting feature of this ordinance is a minimum-lot-size formula which is used in large lot zoning districts where there will be no public sewer systems. The formula considers the various soil types found in a particular area to arrive at a minimum lot size to arrive at a sliding lot-size scale, based on the capability of the land to support septic systems. The lot size in gently sloping, well-drained, erosion-resistant soils would be much smaller, for example, than lot size in moderately sloping, poorly drained, highly erosive soil areas.

Orange County, New York's subdivision regulations divides the county's many soil types into 15 major groups. Since each group is defined according to certain properties, such as slope, and erosion and runoff potential, each one has certain restrictions on development. Two of the major groups, which apply to sloped areas and have special restrictions on development, are excerpted below:

Orange County, New York

GROUP XII. SOILS DEVELOPED IN SANDS AND SILTS THAT ARE INFLUENCED BY STEEP SLOPES, MODERATELY STEEP TO STEEP

A. Characteristics: The soils in this group are all soils that occur on slopes ranging from 15 through 25 per cent. Slope percentages in some units are combined. The range of these soils is 15 through 35 per cent. These soils are rated rapid for surface runoff.

B. Use and Requirements:

1) Septic systems shall not be installed on these soils.

2) Buildings shall not be constructed on these soils except in cases where 50 per cent of the area where the buildings are to be constructed is less than 15 per cent slope (or 4,000 square feet).

3) Erodability on these soils is low to medium, and erosion may be a problem on the "C" slopes.

GROUP XIII. SOILS DEVELOPED IN SANDS, SILTS, AND CLAYS THAT ARE DOMINATED BY VERY STEEP SLOPES

A. Characteristics: The soils in this group are all soils that occur on slopes ranging from 25 through 45 per cent. These soils are rated very rapid for surface runoff.

B. Use and Requirements:

1) Septic systems shall not be installed on these soils.

2) Buildings with and without basements shall not be installed on these soils except in cases where it can be proven that erosion and sluffing will not occur, or necessary measures have been taken to prevent them.

3) Erodability on these soils is high, and erosion and sluffing may be a severe problem.

Through the use of soil surveys, Orange County has been able to refine their regulations to reflect the special capabilities of their critical areas. Some sloped areas are more suitable for development than are others. Some are simply unbuildable because of the nature of their physical properties. Such exacting information, when translated into ordinance form, makes the job of the local planning agency easier.

One important feature of most ordinances based on soil information is providing allowances for additional or more precise information. A common failing of soil surveys is simply that in reviewing several hundred square miles of land it is possible to make an inaccurate evaluation. It is even more possible that the quality of the information is accurate only on a large scale and that refined information will show some significant variation in a site-by-site evaluation. Consequently, most ordinances based on soil surveys allow, and indeed require, prospective developers to submit site surveys. If the results of the site survey conform with the initial findings, then the ordinance applies. If the results show some significant variation, then another class of standards applies.

The use of soil surveys to regulate hillside development is an important advance. Along with the factors of runoff and slope, the potential of soils to erode or slide allows regulations to be tailored to specific areas. This is in obvious contrast to hillside-development regulations which apply across the board to any land with a slope greater than some minimum percentage. Clearly, the more detailed information of soil surveys enables the setting of priorities on a rational basis among various land areas. Some hillside property is more sensitive to erosion than others; some more sensitive to runoff than others; some more sensitive to failure than others. This information enables the local community to make important regulatory distinctions. A developer in hillside area x might be required to take extensive protective measures against erosion while another developer in hillside area y might be required to take similar measures against runoff. For any single site, preventative measures could be focused on the greatest needs of that area.

On the negative side, soil overlays are not an inexpensive undertaking, and without careful monitoring of development changes, information may become quickly dated. There are also some problems with accurate information on a large scale becoming inaccurate on a smaller scale. Further, data on soil characteristics give little information about the constraints of underlying geology, nor is such knowledge equivalent to a hydrological survey. Soil surveys are but one piece of environmental information which can focus the regulatory approach but which in themselves do not account for all factors affecting hillside stability.

Still, if the information on soils is available and reasonably current, there are few more precise sources of information to be used in the regulation of hillside development. With the knowledge of the sensitivity of particular soils, land-use regulations can be more finely tuned to the characteristics of an important natural system.

c. The Guiding Principles Approach--third major approach to the regulation of hillside development is the use of various evaluative principles. While determining the base district as residential, commercial, or industrial sets the primary type of land use in the hillside area, an overlay district is also applied to all lands within the jurisdiction whose average slope exceeds some minimum per cent. The key feature of the overlay district is a set of guiding principles or policies which are utilized by an evaluative body in reviewing development proposals.

The principles themselves may or may not be connected to more exact development standards. In a pure principle approach, no precise standards are contained within the overlay district regulations. In a modified principles approach, precise standards are applied in conjunction with the evaluation principles. Slope-density provisions, for example, may be supplemented by evaluative principles in a modified approach. Two examples of the pure principle approach are found in the Irvine, California, Hillside Development Overlay District and a proposed Hillside Overlay District for Boise, Idaho.

Irvine, California

The policies of the City of Irvine with regard to development in hillside areas are as follows:

A. To preserve the most visually significant slope banks and ridgelines in their natural state by clustering developments into meaningful neighborhood units.

B. Minimize the effects of grading and insure that the natural character of the hillsides is retained.

C. Preserve visually significant rock outcroppings, native plant materials, natural hydrology, and areas of historical or visual significance identified by the General Plan or through the Environmental Impact Report Procedure to the maximum extent possible.

D. To encourage variety in housing types, padding techniques, grading techniques, lot sizes, site design, density, arrangement, and spacing of homes and developments.

E. To encourage innovative architectural, landscaping, circulation, and site design.

F. To discourage mass grading of large pads and excessive terracing.

G. To provide safe circulation of vehicular and pedestrian traffic to and within the hillside areas and to provide access for emergency vehicles necessary to serve the hillside areas.

H. To provide safety against unstable slopes or slopes subject to erosion and deterioation in order to protect human lives and property.

I. To permit only those developments which are not detrimental to the public health, safety, and welfare.

In the Irvine example it is apparent that the range of evaluative policies can be quite broad. The policies stress aesthetic values as well as economic, social, environmental, and public safety values. In contrast, the following Boise proposal tends to emphasize aesthetic and environmental values only.

Boise, Idaho

To this end, the following points shall serve as a basis for evaluating all hillside development proposals.

1. All development proposals shall strive for maximum retention of the natural morphological features and qualities of the site and development shall seek to enhance these natural features and qualities.

2. All development proposals shall take into account and shall be judged by the application of current understanding of land-use planning, soil mechanics, engineering geology, hydrology, civil engineering, environmental and civic design, architecture, and landscape architecture in hill areas. Such current understanding includes but is not limited to:

    a. Planning of development to fit the topography, soils, geology, hydrology, and other conditions existing on the proposed site;

b. Orienting development to the site so that grading and other site preparation is kept to an absolute minimum;

c. Shaping of essential grading to compliment the natural land forms and prohibiting all successive padding and/or terracing of building sites;

d. Developing large tracts in workable units on which construction can be completed within one construction season so that large areas are not left bare and exposed during the winter-spring runoff period;

e. Accomplishing all paving as rapidly as possible after grading;

f. Allocating to open space and recreation uses those areas not well suited to development, as evidenced by competent soils, geology,and hydrology investigations and reports;

g. Landscaping of areas around structures and blending them with the natural landscape;

h. Placement, grouping,and shaping of manmade structures to complement one another and the natural landscape, providing visual interest, and creating a "sense of place" within the development;

i. Demonstrating a concern for the view of the hills as well as the view from the hills;

j. Use of a variety of housing types in residential areas to permit steep slopes, wooded areas, and areas of special scenic beauty to be preserved as scenic easements, through the use of density transfers; such alternatives may include attached dwellings, apartments and condominiums, residential clusters,and groups of various housing types;

k. Special consideration in the design of such visual elements as street lighting, fences, sidewalks, pathways, and other street "furniture" to enable maximum identity and uniqueness of character to be built into each development;

l. Minimizing disruption of existing plant and animal life.

There is a great deal of evaluative expertise required in order to implement the overlay policies. Indeed, generalizations such as "preserve the most visually significant slope . . ." and to "discourage mass grading . . ." and "planning of development to fit the topography, soils, geology, hydrology . . .," leave a wide area for discretion. Success of this approach relies almost exclusively on the effectiveness of the evaluative process.

To use a pure principle approach requires a great deal of specific information about a site. Since the interpretation of the information determines the effectiveness of its regulation, technical and scientific expertise is necessary. Without these resources, which are often unavailable to local agencies, the principle approach becomes ineffective. Thus, while this approach contains the seeds of innovative hillside regulation, it may also contain the potential for a degraded local hillside resource.

In recognition of these drawbacks, a number of communities use a modified-principles method, in which the principles are supplemented by a set of minimum standards which apply exclusively to hillside development. In this case, the principles and standards are contained in the regulations of an overlay district. The base district still sets the primary uses of the area, which may range from planned unit development to exclusive residential or commercial. Within the context of the base district and the minimum standards defined in the overlay district, proposed developments may then be evaluated according to the set of guiding principles. In such cases, the principles are used to determine whether bonuses should be awarded on the basis of a development's innovation or adequacy. These bonuses may be given for innovative site design, extensive open space commitments, or preserving a special landmark or natural resource. Once again, the evaluation is central to the effectiveness of this method, but with supplemental standards there is less room for effectiveness than in those communities which elect the pure-principle approach.

An example of the use of the modified principle approach is found in the Walnut Creek, California, Hillside Planned Development Permit Process. In this process, prospective developments are subject to slope-density minimums. However, base density may be adjusted within a defined range if the evaluative body determines that the proposal meets one of the following characteristics:

Walnut Creek,
California

> In order to encourage hillside developments which take into consideration the above factors, adjustments may be made in the base density in the recommendation for approval and approval of an H-P-D permit, pursuant to any of the following:
>
> (i) The existence of open space beyond that required by subsection (h);
>
> (ii) The existence of amenities or on site or off site improvements which are not normally found or required in residential developments;
>
> (iii) The existence of a mixture of housing types which provides a variation in the appearance of the development and allows a range of

Walnut Creek,
California (cont'd.)

housing prices for differing income levels, and has a projected population which is comparable to or lower than the projected population of a single housing type;

(iv) The existence of landscaping of a type, size and quantity which exceeds that required by this section;

(v) The existence of a topographical feature, including but not limited to a cliff or deep ravine, of a magnitude which causes the weighted incremental slope [average slope] to be significantly greater than would be the case if the topographic feature was not considered; and

(vi) The offer to an acceptance by the City of land in excess of the park land dedication requirements of Section 10-1.516 of this Code.

Of the principles focused on relatively specific local objectives, the necessity for evaluative expertise is not so demanding. For example, a community may specify a certain percentage of open spaces in its hillside areas. If the proposed development can be shown to exceed this goal, then some form of bonus might be granted. This method could be applied to virtually any area of local concern such as low-income housing, varied developments, and school dedication.

The strength of the guiding-principle approach lies in its ability to encourage innovative hillside development. However, when this method is used without any minimum standards, increased evaluative expertise is required of the review group. If such expertise is not available, indiscriminate developments resembling those of flatland practices may result. Conversely, if the expertise is available, the flexibility allowed the developer may produce unique, environmentally sensitive development projects. Still, it is important to consider, as one planning director urges, that "90 per cent of the development industry will come in with the minimum and try to avoid all they can. The other 10 per cent are interested in doing something really worthwhile and look upon these guidelines as an opportunity to do so." Thus many jurisdictions choose a modified planning principles approach whereby minimum standards must be met and some flexibility is retained. This modified method avoids the extensive expertise requirements of the pure principle approach without placing a straightjacket upon any innovative developmental concepts.

3. Grading Control: A Supplement to Hillside-Development Regulations

Grading controls are a necessary supplement to hillside development regulations. They may be found within the hillside regulation or as a supplementary regulation to the hillside ordinance. As the most potentially destructive part of the construction process, regulation of grading is crucial in maintaining the stability of a hillside. Five minutes with modern earthmoving equipment can do more to alter hillside terrain than 500 years of natural processes.

Grading control can be directly included in the hillside regulation itself. With this method, limits are set on the maximum amount of grading which can occur on any given parcel. This approach is generally tied to slope-density provisions which state that as a slope increases the amount of land to be retained in its natural state also increases. Conversely, as slope decreases, the amount of land to be retained in its natural state decreases. In this indirect way, steep-slope areas are subject to less grading than are gently sloping areas. In the Chula Vista, California, Hillside

Modifying District, the percentage of any parcel which can be graded is directly tied to average slope. For example, in a parcel with a 5 per cent average slope, 93.75 per cent of the parcel may be graded, while in a parcel with an average slope of 30 percent, only 10 per cent of the site may be graded. The slope-density approach thus sets basic guidelines to grading. While not establishing exact standards on how the grading occurs, it does establish the maximum area which can be graded.

Beyond this broad standard, most local agencies require a permit before any grading is allowed. Obviously, local agencies allow some exceptions for only light grading activities. Commonly, the exceptions specify that no permit is required if the aggregate volume of earth graded does not exceed a minimum of 100 cubic yards, or so many square feet. Any construction which exceeds these limits would require a grading permit.

In order to be considered for a grading permit, the application must generally be accompanied by a grading plan, which is submitted in conjunction with the development permit application. The grading plan must include information concerning the existing physical characteristics of the area as well as data on anticipated changes as a result of the grading operation. Further, it also calls for a description of the grading process itself which may include exact times and location of proposed earth moving activities. The Placer County, California, Grading Regulation suggests the usual content of a grading plan: The following information shall be required, unless waived by the Director:

1. A vicinity map showing the location of the site or sites involved.

2. An accurate plot plan showing:

   a) The exterior boundaries and dimensions of the property on which the grading is to be performed.

   b) Dimension of the area covered by the application.

   c) Buildings, roads, utilities, or other improvements within the area and adjacent thereto.

3. A map drawn to a scale approved by the Department showing:

   a) Accurate contours at two (2) foot intervals for slopes up to 20% and five (5) foot intervals for slopes over 20% showing the topography of the ground to be graded and filled or cleared and the topogtaphy of the fifteen (15) feet adjacent to such area. Elevation to be based on USGS datum.

   b) The location of observed springs, swampy areas, areas subject to flooding, land slides, and mud flows.

4. A statement of the land capabilities of the property on which the grading is to be performed, including soil name, soil group, hydrologic group, slope, runoff potential, soil depth, erosion potential, and natural drainage.

5. A report and map showing the existing and proposed tree and vegetative cover of the site. (Ref. Sec. 9.07.)

6. A subsurface soil and geological report including subsurface investigations, as may be required in Sec. 9.05 of this Ordinance.

7. A report of the materials involved in the work, including:

   a) classification

   b) suitability of material for the proposed construction

   c) erosion potential

   d) recommendations for construction procedures to obtain the required stability and compaction.

8. A grading plan including the following:

a) Cross section showing both the original and proposed ground surfaces, with grades, slopes and elevation noted.

b) Detailed plans of all drainage devices, walls cribbing, dams, or other protective devices to be constructed in connection with, or as a part of, the proposed work.

c) A map showing the drainage area and estimated runoff of the area served by any drains and proposed methods of runoff disposal. (Ref. Sec. 9.10).

d) A soil stabilization report including final groundcover, landscaping, and erosion control. (Ref. Sec. 9.07).

e) Erosion control measures to prevent soil loss when the grading is in process. (Ref. Sec. 9.12).

f) A description of equipment and methods to be employed in processing and disposing of soil and other material that is removed from the grading site, including the location of disposal sites.

g) A schedule showing when each stage of the project will be completed, including estimated starting and completion dates, hours of operation, and days of week of operation. (Ref. Sec. 9.58).

h) Specifications controlling construction methods and materials in construction of the work, including:

    1) Provisions for control of grading operations within the construction area and on public roads.

    2) Safety precautions to be observed and facilities to be provided.

    3) Compliance with laws and local regulations.

    4) Control of dust (Ref. Sec. 9.14).

    5) Other related matters.

9. Supplementary Data - When requested by the Director, the applicant shall procure and furnish at his own expense additional engineering, geologic, and legal reports, plans

or surveys, and other material necessary to determine evaluate site conditions and the effect of the proposed work on abutting properties, public ways, and public welfare and safety within the purpose of this Division.

10. A statement of the credentials of the person or persons who make the investigation or prepared the reports and plans.

Sec. 9.05 SUBSURFACE INVESTIGATIONS

For the purpose of preparing the soil and geological reports, subsurface investigations shall be performed throughout the area to sufficiently describe the existing conditions.

In particular, subsurface investigations shall be conducted where stability will be lessened by proposed grading or filling or where any of the following conditions are discovered or proposed:

1. At fault zones where past land movement is evidenced by the presence of a fault gorge,
2. At contact zones between two or more geologic formations,
3. At zones of trapped water or high water table, (Ref. Sec. 9.10)
4. At bodies of intrusive materials,
5. At historic landslides or where the topography is indicative of prehistoric landslides,
6. At adversely sloped bedding plains, short-range folding, overturned folds, and other geologic formations of similar importance,
7. At locations where a fill slope is to be placed above a cut slope,
8. At proposed cuts exceeding twenty (20) feet in height, unless in extremely competent rock,
9. Locations of proposed fills exceeding twenty (20) feet in height,
10. Where side hill fills are to be placed on existing slopes steeper than 16%,

11. Wherever groundwater from either the grading project or adjoining properties is likely to substantially reduce the subsurface stability. (Ref. Sec. 9.10).

While the Placer County example is inclusive in the scope of information required, local agencies might pare it down to focus on specific local concerns. Clearly, seismic hazards may not play the same role in central Missouri as they would in jurisdictions adjacent to active faults. Still, with this level of information local agencies are better prepared to evaluate the feasibility of grading in their hillside area.

With the plan and requisite information, local agencies commonly elect one of two approaches in the evaluation of the grading information. In the first method, the plan is evaluated by the resident local expert, such as the city engineer, building engineer, or the planning director. The evaluator's authority range from disapproval of the permit application to requirements for modification to approval.

Often, the evaluator is left with the authority to adjust informational requirements for the plan itself. If, for example, the development is proposed in a particularly sensitive hillside area, the evaluator may require more detailed information concerning an important feature of the resource area. In the same way, the evaluator may modify the grading process or may require more extensive use of various protection devices. In this evaluative approach there are few if any minimum standards defined in the relevant grading provision.

Examples of this approach are taken from Los Gatos, Pacifica, and Placer County, California.

Los Gatos, Calif.
Sec. 18-A.13:
Grading

> No grading for which a grading permit is required by the Town of Los Gatos regulations shall be authorized except upon the securing of Architectural and Site Approval. The Architecture and Site Committee shall not grant approval for such grading except upon a finding that the purpose for which the grading is proposed is essential for the establishment or maintenance of a use which is expressly permitted herein and that the design, scope, and location of the grading proposed will be compatible with adjacent areas and will result in the least disturbance of the terrain and natural land features. All grading for which no permits or approval are required shall be subject to the provisions set forth in Section 18-A.14 of this Article.

In Los Gatos, the evaluation is made by the Architectural and Site Committee. The section contains few guidelines, leaving the committee wide latitude in evaluating a plan.

In Pacifica, the relevant section of the ordinance spells the criteria a little further but still leaves the evaluation to the experts. In this case, the plan must be approved by both the Planning Director and the City Engineer.

Pacifica, California
Sec. 9-4.2211:
Grading and excavation permits

> No grading or excavation permit shall be issued by the City for any location in a P-D District or Hillside Preservation District unless the permit has the approval of the Director of Community Development and the City Engineer, who shall ensure that the issuance of the permit will not result in effects inconsistent with the purposes of this article or Article 22.5 of this chapter if such P-D District falls within the HPD District. For P-D District within the HPD District, the Director of Community Development and the City Engineer may, at their discretion, refer the permit to the HPR Board for its review. Approval of the permit shall be contingent upon the following conditions;

(a) The grading plan and work shall be directly related to an approved specific plan.

(b) Any grading and excavation shall be necessary for the establishment or maintenance of an approved specific plan.

(c) The design, scope, and location of the grading and excavation will cause minimum disturbance of the terrain and natural features of the land commensurate with the purpose of the grading and excavation work.

(d) All persons performing any grading and excavation operation shall put into effect all necessary safety precautions to minimize erosion, protect any watercourses and other natural features, protect the health and welfare of all persons, and protect private and public property from damage of any kind.

(e) The City shall place certain conditions on time limits and necessary site restoration and shall undertake measures to assure fulfillment of such conditions, for any grading and excavation work.

Placer County, California, establishes more specific criteria for evaluation of grading plans.

Sec. 9.03 GENERAL CRITERIA

All grading and clearing operations, when a permit is required under these regulations, shall be designed:

1. To preserve, match, or blend with the natural contours and undulations of the land.
2. To retain trees and other native vegetation, to stabilize hillsides, retain moisture, reduce erosion, siltation, and nutrient runoff, and preserve the natural scenic beauty.
3. To minimize scars from cuts and fills.

4. To reduce the amount of cuts and fills and to round off sharp angles at the top and toe and sides of all necessary cut-and-fill slopes.

5. To limit development on steep or hazardous terrain.

6. To compensate for geologic hazards and adverse soil conditions and their effect on the future stability of the development.

7. So that all cleared slopes, including ski slopes, cuts and fills, and other areas vulnerable to erosion shall be stabilized.

8. So that construction, clearing of vegetation, or disturbances of the soil be limited to those areas,of proven stability.

9. So that the natural geologic erosion of hillsides, slopes, graded areas, cleared areas, filled areas or streambanks will not be exceeded.

10. So that sediment or other material deposited in any lake, its flood plains, or its tributaries, or any other public or private lands will not exceed that which would have been deposited if the land had been left in its natural state.

In the absence of minimum standards, evaluation of grading plans places total reliance upon the expertise of the evaluator. There are no simple rules or devices to serve as basic indicators of the feasibility of the grading proposal. Further, this method presumes a great deal of technical knowledge which is rarely found in the smaller local planning agencies. Clearly, this method of expert evaluation has its pitfalls. If the real expert is available, then perhaps this approach lends both flexibility and sensitivity to the development process. If not, the local agency may find its evaluative process ineffective.

The second type of approach to grading control combines a series of basic development standards with expert evaluation. Typically, the standards cover cuts, fills, grading on steep slopes, composition of materials used in fills, and perhaps such features as retaining walls and the placement of excavated materials.

Standards relating to cuts are mainly concerned with the steepness of the finished slope. Table VIII-4 identifies a range of standards:

Table VIII-4. Cuts-Steepness of Finished Slope

Jurisdiction	Steepness of Finished Slope
Santa Fe, N.M.*	1' Horizontal to 1' Vertical
Palo Alto, Calif.	1-1/2' Horizontal to 1' Vertical
Phoenix, Az.	1-1/2' Horizontal to 1' Vertical
Boise, Id.*	2' Horizontal to 1' Vertical
Allegheny, Pa.**	3' Horizontal to 1' Vertical

*Proposed

**Model Ordinance

The standards for the steepness of slope resulting from cuts varies considerably. These standards reflect specific local concerns in the capability of hillsides to support various cuts. The most restrictive standard of 1' Horizontal to 1' Vertical applies to sloped areas that are quite sensitive to any alteration. Cuts in such areas could produce slope failure or other hazards. Some flexibility in the standard may be allowed by such regulations, depending upon the evaluation of the local city engineer. Standards could then be adjusted to reflect the specific capacities of the particular parcel under consideration.

In a few cases, standards define some maximum limits of proposed cuts. In Boise, for example, the proposed ordinance suggests that cuts be limited to a height of 30' and a length of 400'. In Weber County, Utah, the maximum is placed in the height only of the cut, in this case it cannot exceed 25'. However, most ordinances do not place maximum boundaries of the size of the cut, but rather on its finished dimensions.

Standards for fills commonly include provisions affecting the type of material used for the fill, degree of compaction required, and the steepness of the finished slope. Table VIII-5 compares various requirements relating to fills. As should be evident, the standards for fill fall into a closely defined range. There is variation in the requirements for finished slope but this reflects the special characteristics of the local area. As a general rule, those areas experiencing some difficulty in preventing slope failure should require more exacting minimum standards relating to the final finished slope of the fill. The city engineer or registered engineering geologist would be able to indicate the relative state of stability.

Standards regulating the type of fill material generally prohibit the use of organic material, which, upon decomposition, would present severe stability problems. Also, many ordinances prohibit the use of rocks which exceeds one maximum diameter, usually 8 inches. If large, various sized rocks were allowed, the stability of the slope would be less than that of smaller more uniform material, which is more easily compacted and stabilized by

Table VIII-5. Standards for Fills

Jurisdiction	Materials	Compaction*	Steepness of finished slope
Orange County, Calif.	- No Organic - No Rock greater than 8" in diam.	minimum to 90% of max. Density	Not greater than 2' Horizontal to 1' Vertical .
Allegheny, Pa.** (Model)	- No Organic - Compacted - Setback for Sturctures	No minimum	3' Horizontal to 1' Vertical
Weber County, Utah	- No Organic	Minimum to 90% of max. Density	Not greater than 2' Horizontal to 1' Vertical
Palo Alto, Calif.	- No Organic	Minimum to 90% of Max. Density	Not greater than 1 and 1/2' Horizontal to 1' Vertical
Phoenix, Ariz.	- No Organic - No Rock greater than 8" in Diameter	Minimum to 90% of max. Density	Not greater than land 1/2' Horizontal to 1' Vertical
Boise*, Idaho***	- No Organic	95% of Max. Density	Not greater than 2' Horizontal to 1' Vertical

*Compaction of fill materials is usually required in fill areas which support structures.

**Allegheny Ordinance is a Model Grading Ordinance.

***Boise Ordinance is proposed.

vegetation. Further, the surface of the fill area must generally be covered with topsoil, which allows revegetation in order to prevent erosion, sedimentation and further loss of stability.

Standards for the compaction of the fill fall within a narrow range, depending upon the structures which will be placed upon it. Buildings, roads, and parking lots require a high percentage of density in order to support their weight.

Minimum standards such as those outlined here provide the community with at least some basic assurance that grading will not destroy the hillside outright. Further, these standards lessen the requirements for expert evaluation, providing at least some, even though crude, criteria for evaluation. This approach is useful to smaller agencies with limited evaluative resources.

4. Maintenance of Cover and Erosion Control

A crucial factor in maintaining the stability of a hillside in preserving as much vegetation as possible, or assuring that exposed soil is revegetated or otherwise protected from runoff and erosion. Some of the preceding regulatory approaches consider this necessity. Slope-natural state provisions, for example, require a certain percentage of a developed slope to be retained in its natural state, thereby protecting vegetation cover. Soil overlays identify easily erodible soils and limit disturbance of them and cover as a result of development. Guiding principles may explicitly provide for the maintenance of vegetation and other erosion-prevention measures, as may grading regulations. However, vegetation removal and erosion are best handled by separate erosion control ordinances which are important supplements to hillside regulations. (These are discussed in detail in Section IV "Streams and Creeks.")

D. Developing Hillside-Protection Programs

Each major approach to the regulation of hillside development requires different types and amounts of site information. But how that information is evaluated is a crucial factor. Of the three methods the pure-principle approach would require the most extensive information, but in order to be an effective approach there must be evaluative expertise. Consequently, in choosing among regulatory methods it is wise to first determine a local community's evaluative capability. Another important factor in informational requirements is the characteristics of the local setting and the key hillside problem areas, such as erosion, slope failure, or runoff. Some problems will require different or more precise information than others. Also, community attitudes, such as maintaining natural on seminatural areas on hillsides, may require detailed wildlife and vegetation surveys. Still, in addition to these general considerations of environmental information, each of the three major regulatory approaches has unique requirements.

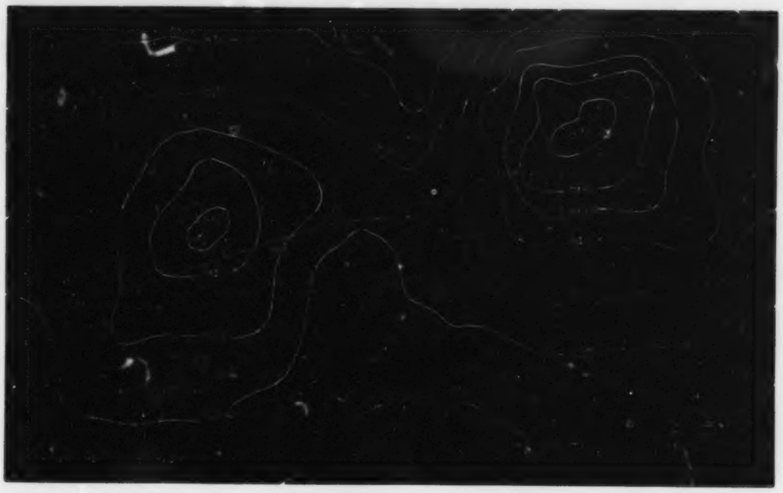
1. Slope-Density Requirements--If slope-density provisions use hillside districts, the community must be able to identify the appropriate boundary of the district. This can generally be accomplished through the use of USGS maps. Districts can include all slopes greater than some minimum, which may

range from everything over 5 per cent to everything over 20 per cent. Beyond the initial district designation, slope density also requires site-specific information in order to determine such things as number of dwelling units permitted, minimum lot size, and open space requirements. In a number of jurisdictions, this information is also used to determine which land should be entirely excluded from development. For example, in Anderson, California, no development is allowed on slopes exceeding 30 per cent while in Pacifica, California, no development is allowed on slopes exceed-35 per cent. In the Town of Lenox, N.Y. no development is allowed on slopes exceeding 10 per cent when the slope is in a conservation district. Site-specific information must thus account for these various requirements.

The chief source of information for slope-density provisions is a contour map. (See figure VIII-6.)

Figure VIII-6

Contour map



The contour map, which must use contour intervals of 10 feet or less, supplies the necessary data to use the following formula for determining the average slope of a parcel. Average slope is usually expressed as a percentage and is determined by the formula $S=\frac{.0023\ I\ L}{A}$, where:

S - the average slope in per cent

.0023 is a conversion factor of square feet to acres

I = contour interval in feet

L = the combined length of the contour lines in scale feet

A = the gross area in acres of the parcel or lot

The conversion factor (.0023) translates I (contour interval in feet) times L (the combined length of contour lines in scale feet) into the common unit of acres, thus solving the apples (feet) and oranges (acres) problem. I (contour interval in feet) is the distance in feet between the contour lines which connect points of the same elevation. In order for this equation to be accurate to one per cent, the contour interval must be 10 feet or less. For this reason, USGS topographical maps are inappropriate since their usual interval of 20 feet yields an unacceptable error of five per cent. Moreover, the horizontal map scale should be at least 1": 200' to determine "L." L (the combined length of the contour lines in scale feet) is determined from the map with the use of a planemeter. This device, looking somewhat like a pizza cutter, is traced around each contour line. The length of each line is summed to determine the combined length of all lines. A (the gross area in acres of the parcel or lot) is readily available from the legal property description. With this information and after subtracting out all undevelopable (if any) segments of the property that are too steeply sloping according to regulation, the average developable slope may easily be determined. Average slope is then used to determine allowable number of dwelling units, minimum lot sizes, open space requirements, or the maximum area which may be graded.

Although many cities and counties have the appropriate contour maps, requiring the developer to provide a survey and contour map of the land is not an unreasonable demand. Since these maps are useful for many purposes and are even necessary in the design and construction process, developers rarely complain about such requirements. Consequently, information for slope-density provisions is not expensive.

Further, the task of determining average slope is relatively simple and easily within the capabilities of most planning agencies. Since the slope-density approach has a minimum informational requirement, it is useful for a large, well-staffed planning agency as well as a one or three person agency.

2. Soil Overlays--soil overlays, on the other hand, require far more extensive information before the writing of an ordinance or regulation. Usually this information is gathered on a cost-sharing basis between the local agency and the local or regional soil conservation agency. In a few cases, the information is already available as a result of previous investigations for other local or state agencies. In any event, the information requirements for soil overlays are quite high and rarely within the capabilities of a local planning agency.

Although it is an expensive undertaking, once the information is available it is easily adaptable to ordinance form. With uses closely tied to soil capabilities, it is an excellent regulatory device which requires little more than a continued reference to soil groups and soil types in order to determine special developmental standards. Since the information suffers some of the common maladies of large-scale surveys, ordinances generally require specific soil interpretations at the site in order to effectively evaluate conformance with the initial survey and also to allow for changes in the initial survey. Small-scale surveys are within the resource limits of most developers and, as with contour maps, are quite useful in the development process. Developers, therefore, rarely complain about these additional requirements.

With the information available, requirements for evaluative expertise are minimal. Since no evaluative formulas are required and there is generally little room for negotiation on the essential information, the need for staff expertise is slightly less than slope-density provisions and far less than for the pure-principle approach. While additional resources such as consultants, are necessary to develop the soil survey and translate it to ordinance form follow up information is provided by the developer.

3. Guiding Principles--information requirements and evaluative expertise are quite demanding for the pure-principle approach. Since the principles tend to cover a variety of local objectives, the number of areas for which information is needed is large. Further, since any single principle can be evaluated in a number of ways, the possible range of information

on any single subject area could also be quite large. When the number of concerns is combined with varying information requirements for any single one, the planning staff, planning commission, and council assume an extensive review responsibility. Except for areas with unique community resources, it is doubtful that an agency can assemble the information and expertise. Clearly, this approach is beyond the capabilities of the small city or county staff and even stretches the resources of medium-sized communities.

Because of the expertise and information requirements, the success of the pure-principle approach depends upon the involvement of the local and state agencies. The Soil Conservation Service, for example, may be called to evaluate the nature, distribution, and strength of soils on the proper grading procedures to minimize hazards, or necessary corrective designs. The USGS can evaluate hydrological impacts or geological conditions, and a select group of local citizens might be formed to evaluate proposals in their personal areas of expertise. In any event, this approach requires information and evaluation which are not normally available at the local level. If this approach is to be taken, local jurisdictions are well advised to review their internal evaluative capability as well as the availability of outside resources.

4. Other Requirements--aside from the informational requirements of the basic approach selected, developers are commonly expected to furnish other information. This information, which focuses on the characteristics

of the site both before and following the development, is an environmental impact statement of a very special nature.

Most regulations commonly call for information on the present condition of soils, geology, and hydrology, as well as the anticipated condition of them after development. One example of these requirements is taken from the proposed ordinance for Boise, Idaho. Since a number of local, regional, state and federal agencies played a role in drawing up the proposal, the requirements reflect a variety of perspectives on key environmental questions.

Boise, Idaho
(proposed)

Soils Report

a. Any area proposed for development shall be investigated to determine the soil characteristics, and a soils engineering report shall be submitted with every application. This report shall include data regarding the nature, distribution and strength of existing soils, conclusions and recommendations for grading procedures, design criteria for corrective measures, and opinions and recommendations covering the adequacy of sites to be developed;

b. The investigation and subsequent report shall be completed and presented to the Commission by a professional engineer registered in the State of Idaho, and experienced and knowledgeable in the practice of soils mechanics;

c. Recommendations included in the report and approved by the engineer shall be incorporated into the design plan or specifications;

d. Any area which presents one or more of the following limiting factors shall not be subjected to development unless the engineer can demonstrate conclusively to the Commission that these limitations can be overcome in such a manner as to prevent hazard to life, hazard to property, adverse affects on the safety, use or stability of a public way or drainage channel, and adverse impact on the natural environment;

i. Water table within six (6) feet of the surface at any time of the year;

ii. Natural slopes greater than 15 per cent;

iii. Soils with a high shrink-swell potential, that is, soils where the co-efficient of linear extensibility (COLE) is equal to or greater than 0.06, or where the Potential Volume Change (PVC) (as used by the Federal Housing Administration) is equal to or greater than 4;

iv. Soils with a unified classification of CH, MH, OL, OH, or PT [unstable soil types].

2. Geology Report

a. Any area proposed for development shall be investigated to determine its geological characteristics and a geology report shall be submitted with every application. This report shall include an adequate description, as defined by the Commission, of the geology of the site, conclusions and recommendations regarding the effect of geologic conditions on the proposed development, and opinions and recommendations covering the adequacy of sites to be developed.

b. The investigation and subsequent report shall be completed and presented to the Commission by a professional geologist registered in the State of Idaho, and experienced and knowledgeable in the practice of engineering geology;

c. Any area in which the investigation indicates geological hazards shall not be subjected to development unless the geologist can demonstrate conclusively to the Commission that these hazards can be overcome in such a manner as to prevent hazard to life or limb, hazard to property, adverse affects on the safety, use or stability of a public way or drainage channel, and adverse impact on the natural environment.

3. Hydrology Report

a. Any area proposed for development shall be investigated to determine its hydrological characteristics, and a hydrology report shall be submitted with every application. This report shall include an adequate description, as defined by the Commission, of the hydrology of the site, conclusions and recommendations regarding the effect of hydrologic conditions on the proposed development, and opinions and recommendations covering the adequacy of sites to be developed;

b. The investigation and subsequent report shall be completed and presented to the Commission by a qualified registered professional experienced and knowledgeable in the science of hydrology and in the techniques of hydrologic investigation;

c. Any area in which the investigation indicates hydrological hazards shall not be subjected to development unless the developer can demonstrate conclusively to the Commission that these hazards can be overcome in such a manner as to prevent hazard to life or limb, hazard to property, adverse affects on the safety, use of stability of a public way or drainage channel, and adverse impact on the natural environment;

d. Flood frequency curves shall be provided for the area proposed for development.

In addition to information on soils, geology, and hydrology, another increasingly common requirement is for a survey of existing vegetative cover and how it will be altered. This is particularly important in wooded areas where trees and shrubs serve so many environmental functions. The purpose of this requirement is to ensure that the vegetative cover is retained to the maximum feasible extent. Since it is often the case that the process of development is much easier and less expensive with the absence of trees and other vegetation, a vegetation survey enables local jurisdictions to more fully evaluate the positive features of the site. In this way, important community resources can be preserved.

NOTES

1. Charles A. Yelverton, "The Role of Local Governments in Urban Geology" Environmental Planning and Geology in the Urban Environment, eds. Donald R. Nichols and Catherine C. Campbell (Washington, D.C.: U.S. Government Printing Office, 1971), pp. 80-81

2. Livingston and Blaney, Foothills Environmental Design Study, Report No. 3 to the City of Palo Alto, California, May 1970, "Public Costs Are Extensive in Hillside Areas." Indeed, the report concludes, ". . . that over a 20-year period the cummulative cost of city purchase of all land would be less than the public cost for residential development averaging 2 or 4 units per acre. . . ." (pp. 51.)

3. Don J. Easterbrook, Principles of Geomorphology (New York: McGraw-Hill, 1969), p. 225.

4. Easterbrook, p. 227.

5. For further reading on mass land movement and components of slope stability see Easterbrook, Chapter II.

6. For a more detailed consideration of erosion; types of erosion and processes involved, see: Hugh Hammon Bennett, Soil Conservation (New York: McGraw-Hill, 1939), Chapter 9.

BIBLIOGRAPHY

Association of Engineering Geologists, Los Angeles Section. Environmental Geology in Southern California, edited by Richard Lung and Richard Proctor. Arcadia, California. October 1966 (reprinted 1969). 387 pp. figs., plates.

> A compilation of the wealth of geological information about Southern California for use by both geologists as well as such interested laymen as planners, developers, and public administrators.

Detwyler, Thomas R. and Melvin G. Marcus and others. Urbanization and Environment. Belmont, California. 1972.

> Of interest in this work are the second and sixth chapters; "The Geologic and Topographic Setting of Cities," and "Soil and the City." The first considers the geologic landscape on which cities are built and examines the criteria by which sites for cities are selected. It also lists some of the problems that have arisen as a result of poor choice. Chapter six is a similar consideration but relating specifically to soil. It discusses erosion and siltation, degradation of soil, and the results of improper siting of development, including ground subsidence, landslides, earthquake damage, etc. There is a final section on Soils and Planning which touches upon the idea that consideration of soil and geologic characteristics will be necessary to prevent unnecessary damage from natural hazards.

Easterbrook, Don L. Principles of Geomorphology. New York. 1969.

> An excellent basic textbook on gemorphology, the study of the movement of land and land masses of the earth. It includes discussions of erosion, stream and hillside stability and geologic hazards. Well illustrated and concise.

Flawn, Peter T. Environmental Geology: Conservation, Land-Use Planning, and Resource Management. New York. 1970. 313 pp.

> This book discusses the properties of the materials that make up the earth and the processes that affect those materials with regard to the presence of humans. There are chapters on the engineering properties of soil and the geological consequences of civilization and industrialization. Chapter six, conservation and management, considers proper mamagement of the environment and alternatives to present practices.

Nichols, Donald R., and Catherine C. Campbell, Coeditors. Environmental Planning and Geology, proceedings of the Symposium on Engineering Geology

in the Urban Environment arranged by the Association of Engineering Geologists for their October 1969 National Meeting in San Francisco. Published cooperatively by the Geological Survey, U.S. Department of the Interior and the Office of Research and Technology, U.S. Department of Housing and Urban Development (Washington: U.S.G.P.O., December , 1971). 204 pp.

> This is probably the most comprehensive treatment of the relationship between geology and urban development yet produced. It includes a wealth of information and ideas about the ways geological studies can improve development and minimize hazards.

DATA NEEDS AND TECHNICAL ASSISTANCE

Data needs for hillsides can be broken down into the following: soil type, topography (degree of slope), geologic hazards, and hydrology.

Soil type and degree of slope are the major factors that determine the potential for erosion on a hillside. The SCS soil survey maps available for many counties indicate both the slope and soil type and classify the land according to its use suitability. Although this classification of land into management groups is primarily concerned with agricultural use, the maps do indicate the soils and slopes that should be left to natural cover and wildlife use. The SCS surveys are available through the local SCS people to help you evaluate them. (See Appendix E, page 512.)

In some areas of the country seismic zones, slumps, and slides are common. You may want to check with the state geological survey or the U.S.G.S. to find out if your community has any hazards associated with it. The geological survey hydrologists can also help you analyze the relationship of a hillside to the watershed. (See Appendices G and H, pp. 517 and 518.) What streams or wetlands will be effected by its erosion? How easily might it be stabilized once erosion has occurred?

The vegetation of a hillside may represent a unique community; a north facing slope may support plant species usually found much farther north, or a prairie may occur on a southern slope. A plant and wildlife inventory by SCS, Cooperative Extension Service, or state wildlife people might be useful in determining the value of plant communities on the hillsides. (See Appendices B and E, pp. 505 and 512.)

A SELECTED LIST OF COMMUNITIES WITH HILLSIDE REGULATIONS

Anderson, California
Planning Department
1887 Howard Street
Anderson, California 96007

Boise, Idaho
ADA Development Council
525 W. Jefferson
Boise, Idaho 83702

Claremont, California
City Planning Department
P.O. Box 232
Claremont, California 91711

Chula Vista, California
Department of Planning
276 Fourth Avenue
Chula Vista, California 92010

Colorado Springs, Colorado
City Planning Commission
Box 1575
Colorado Springs, Colorado 80901

Contra Costa County, California
Planning Commission
P.O. Box 951
Martinez, California 94553

Irvine, California
Planning Department
P.O. Box DZ
Irvine, California 92664

Kentucky
Northern Kentucky Area Planning
Commission
P.O. Box F
11th and Lowell
Newport, Kentucky 41072

Los Gatos, California
Planning Department
P.O. Box 949
Los Gatos, California 95030

Oak Ridge, Tennesse
Planning Department
Municipal Building
Oak Ridge, Tennessee 37830

Pacifica, California
Planning Department
170 Santa Maria
Pacifica, California 94044

Palm Springs, California
Planning Department
3200 Tahquitz-McCallum Way
Palm Springs, California 92262

Phoenix, Arizona
Planning Department
801 Municipal Building
Phoenix, Arizona 85003

Pittsburgh, Pennsylvania
City Planning Department
Public Safety Building
Pittsburgh, Pennsylvania 15219

Red Wing, Minnesota
Red Wing Advisory Planning Commission
Red Wing, Minnesota 55066

Redwood City, California
Planning Department
P.O. Box 391
Redwood City, California 94064

Richmond, California
City Planning Department
City Hall, Civic Center
Richmond, California 94804

Roslyn, New York
Planning Department
Town Hall
Roslyn, New York 11576

San Diego, California
Planning Department
City Administration Building
202 C Street
San Diego, California 92101

San Mateo, California
Department of City Planning
Civic Center
San Mateo, California 94403

Santa Barbara County, California
Planning Department
P.O. Drawer PP
Santa Barbara, California 93102

Santa Clara, California
Planning Department
1500 Warburton Avenue
Santa Clara, California 95050

Santa Fe, New Mexico
Planning Department
P.O. Box 909
Santa Fe, New Mexico 87501

Santa Rosa, California
Planning Department
P.O. Box 1678
Santa Rosa, California 95403

Thousand Oaks, California
Planning Department
401 W. Hillcrest Drive
Thousand Oaks, California 91360

Walnut Creek, California
Walnut Creek Community Development
Department
1445 Civic Drive
Walnut Creek, California 94596

Weber County, Utah
County Planning Department
County Building
Ogden, Utah 84401

West Covina, California
Planning Department
1444 W. Garvey Avenue
West Covina, California 91790

Grading Regulations:

Allegheny County
Department of Planning
1500 Allegheny Building
429 Forbes Avenue
Pittsburgh, Pennsylvania 15219

Orange County, California
Planning Commission
400 Civic Center Drive West
Santa Ana, California 92701

Phoenix, Arizona
City Planning Department
801 Municipal Building
Phoenix, Arizona 85003

Palo Alto, California
Department of Planning and Community Development
250 Hamilton Avenue
Palo Alto, California 94301

Portola Valley, California
Planning Department
Town Hall
Portola Valley, California 94025

San Francisco, California
Department of City Planning
100 Larking Street
Civic Center
San Francisco, California 94102

Tahoe, California
Tahoe Regional Planning Agency
P.O. Box 8896
South Tahoe, California 92502

APPENDIX VIII-a--SLOPE DENSITY

EXCERPT FROM THE PACIFICA MUNICIPAL CODE
REGARDING: P-D REGULATIONS
H-D ORDINANCE

Article 22. Planned Development District (P-D)

Sec. 9-4.2201. Scope (P-D).

Subject to all other regulations set forth in this chpater, uses shall be permitted and regulations shall apply in the Planned Unit Develpment District (P-D) as set forth in this article. (Sec. 4.16, Ord. 363)

Sec. 9-4.2202. Purpose (P-D).

The purpose of the Planned Development District (P-D) is to allow diversification of the relationships of various buildings, structures, and open spaces in planned building groups, while insuring substantial compliance with the district regulations and other provisions of this chapter, in order that the intent of this chapter that adequate standards related to the public health, safety, and general welfare shall be observed without unduly inhibiting the advantage of large scale site planning for residential, commercial, or industiral purposes. The amenities and compatibilities of the P-D District shall be insured through the adoption of a development plan and specific plans showing proper orientation, desirable design character, and compatible land uses. To this end, the use of the Planned Development District (P-D) is encouraged.

Sec. 9-4.2203. Uses permitted (P-D)

The uses permitted in the Planned Development District (P-D) shall be the uses designated on the approved development plan; provided, however, in the event such approved usage does not conform to the General Plan of the City, the General Plan shall be amended to conform to the development plan simultaneously with the amending of the zoning map classifying the parcel P-D.
(Sec. 4.162 (C), Ord. 363)

Sec. 9-4.2204. Development standards (P-D).

The following provisions shall apply in the Planned Development District (P-D), which district shall also be subject to the other provisions of this chapter; provided, however, where conflicts in regulations occur, the regulations set forth in this section or in the development plan or specific plans approved pursuant to the provisions of this section shall apply:

(a) Size. The minimum size of any parcel for which an application for a P-D District shall be accepted shall be five (5) contiguous acres, except as otherwise provided for the Hillside Preservation District in this subsection. The entire parcel shall be in one ownership, or the application shall be made by, or with the written authorization for such action on behalf of, all property owners concerned and the applicant, together with a statement signed by interested owners that they agree to be bound by the regulations and conditions which shall be effective within the district. Any parcel of land, regardless of size, in the Hillside Preservation District (HPC) shall meet the requirements and provisions of the HPD regulations, except as otherwise set forth in this chapter. The five (5) acre minimum standard for P-D Districts shall not apply to the Hillside Preservation District.

(b) Other regulations. Regulations for area, coverage, density, yards, parking, height, and open ground area for P-D District users shall be governed by the regulations of the residential, commercial, or industrial zoning districts most similar in nature and function to the proposed P-D District uses as determined by the Commission and the Council. Regulations for public improvements and subdivisions shall be governed by applicable laws of the City. Exceptions to such regulations by the Commission and the Council shall be permitted when the Commission and Council find that such exceptions encourage a desirable living environment and are warranted in terms of the proposed development, or units thereof, in accordance with the regulations and limitations set forth in this article.
(Sec. 4.162(A) and (B), Ord. 363, as amended by Sec. 2, Ord. 69-C.S., eff. December 27, 1972)

Sec. 9-4.2205. Development plans: Applications: Fees (P-D).

(a) Simultaneously with an application to classify a parcel to a Planned Development District (P-D), the applicant shall submit a development plan showing the area involved and/or a narrative containing the following elements:

(1) The circulation pattern, indicating both public and private streets;

(2) All parks, playgrounds, school sites, public buildings, open space, and other such uses;

(3) The land uses, indicating the approximate areas to be used for various purposes, the acreage and percentage of total area in each land use, the population densities, the lot area per dwelling unit (excluding public street area), the percentage of area covered by buildings, and land uses on adjacent parcels;

(4) A map showing the topography of the proposed district at one foot contour intervals in areas of cross slope of less than five (5%) percent, at two (2') contour intervals in areas of five (5%) percent through ten (10%) percent cross slope, and at five (5') foot contour intervals in areas exceeding ten (10%) percent cross slope;

(5) The following studies of the proposed development:

(i) An economic analysis in conformance with a form provided by the City;

(ii) A market analysis for proposed commercial developments;

(iii) An environmental impact statement which shall include the following major elements in conformance with an outline provided by the City and the provisions of the Environmental Quality Act of the State (1970):

(aa) The environmental impact of the proposed action;

(ab) Any adverse environmental effects which cannot be avoided if the proposal is implemented;

(ac) Mitigation measures proposed to minimize the impact;

(ad) Alternatives to the proposed action;

(ae) The relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity; and

(af) Any irreversible environmental changes which would be involved in the proposed action should it be implemented;

(iv) A general list of price ranges (both sale and rental) for proposed residential developments; and

(v) A geological analysis which shall contain an adequate description of the geology of the site and conclusions and recommendations regarding the effect of geological conditions on potential grading, excavations, street and utility improvements, and structures.

For any development proposal within the Hillside Preservation District which is less than five (5) acres, the provsiions of subsections (i), (ii), and (iii) of this subsection shall be required unless conditions warrant the waiver of said provisions by the Commission; and

(6) A development schedule indicating the approximate data on which the construction of the project can be expected to begin, the anticipated rate of development, and the completion date. There shall also be included, if applicable, a delineation of units or segments to be constructed in progression.

(b) Development plans and, thereafter, specific plans shall be approved by the City before building permits may be issued for areas classified P-D for which development plans have not been approved prior to the adoption of the provisions of this chapter. The procedure for the approval of such plans shall be as set forth in subsection (a) of this section and Section 9-4.2208 of this article.

(c) Each application for the classification and/or approval of development plans shall be accompanied by a fee as set forth in Article 37 of this chapter. (Sec. 4.163, Ord. 363, as amended by Sec. 2, Ord. 69-C.S., effective December 27, 1972)

Sec. 9-4.2206. Development plans: Hearings: Approval (P-D).

The Commission shall set a public hearing within forty-five (45) days after the filing of any complete development plan application unless the Commission otherwise receives a written request by the applicant to extend this time. For any proposal within the Hillside Preservation District, the HPR Board shall make its recommendation to the Commission within thirty (30) days after the filing of any complete development plan application. The Commission, after a public hearing, may recommend the establishment of a Planned Development District (P-D), and the Council, after a public hearing, may, by ordinance, establish a P-D District provided they find the facts presented at the hearings establish that:

(a) The proposed P-D District can be substantially completed within the time schedule submitted by the applicant;

(b) Each unit of the development, as well as the total development, can exist as an independent development capable of creating an environment of sustained desirability and stability or adequate assurance that such objectives will be attained;

(c) The land uses proposed will not be detrimental to the present or potential surrounding uses but will have a beneficial effect which could not be achieved through other districts;

(d) The streets and thoroughfares proposed are suitable and adequate to carry anticipated traffic, and increased densities will not general traffic in such amounts as to overload the street network outside the P-D District;

(e) Any proposed commercial development can be justified economically at the location proposed and will provide adequate commercial facilities for the area;

(f) Any exceptions from the standard district requirements are warranted by the design of the project and amenities incorporated in the development plan; and

(g) The area surrounding the development can be planned and zoned in coordination and substantial compatibility with the proposed development, and the P-D District uses proposed are in conformance with the General Plan of the City or that changes in the General Plan are justified.
(Sec. 4.164, Ord. 363, as amended by Sec. 2, Ord. 69-C.S., eff. December 27, 1972)

Sec. 9-4.2207. Development plans: Denial: Approval with conditions (P-D).

(a) If, from the facts presented, the Commission or the Council is unable to make the necessary findings, the application to establish a P-D District shall be denied.

(b) The Commission may recommend disapproval of the development plan as submitted or may recommend approval of such plan, subject to specified amendments and modifications. No amendments or modifications to the development plan shall be recommended or made without the consent of the applicant. If the applicant does not agree to the suggested changes, the Commission shall recommend disapproval of the development plan.

(c) The Commission shall not make a favorable recommendation to the Council, nor shall the Council adopt an ordinance classifying a parcel P-D, without first having approved the development plan.

(d) The approved development plan shall become a part of the zoning map, subject to the provisions of subsection (e) of this section, as provided in Section 9-4.302 of Article 3 of this chapter. All modifications or amendments to the development plan shall be made in accordance with the procedures set forth for the amendment of this chapte. If, in the opinoin of the Commission or the Council, the development in a P-D District is failing or has failed to meet the requirements of the development plan, or any part thereof, the Commission or Council may initiate proceedings to reclassify the property to another zoning district.

(e) Development plans approved in accordance with the provisions of this article shall become null and void if a specific plan, or the first of multiphase specific plans, is not filed with the Commission within one year after the effective date of the ordinance adopting the approved development plan. The provsions of this subsection shall be subject to reasonable extensions of such time upon a showing by the applicant of extraordinary or uncontrollable circumstances warranting such extensions.
(Sec. 4.165, Ord. 353, as amended by Sec. 2, Ord. 69-C.S., eff. December 27, 1972)

Sec. 9-4.2208. Specific plans: Submission (P-D).

Prior to the issuance of a building permit in any parcel zoned P-D or within a defined Hillside Preservation District, the owner or applicant shall submit the following:

(a) A tentative subdivision map;

(b) Proposed landscaping plans;

(c) Proposed engineering plans, including site grading, street improvements, drainage, and other public utilities, which plans shall be tentative in nature, and their approval shall not be construed to mean that the plans will constitute the final improvement plans for the subdivision. The City Engineer, after detailed design studies, may require modifications and/or additional plans and specifications. Such additional requirements requested by the City Engineer after the design studies may be made without a public hearing;

(d) For proposed developments within the Hillside Preservation District, a proposed grading plan based on the following criteria:

(1) The front boundary;
(2) Streets;
(3) Lots;
(4) Storm drainage systems;
(5) Existing and proposed contours;
(6) Slope ratios for heavy grading;
(7) The location of easements for drainage;
(8) The location of benches on slopes;
(9) Retaining walls; and
(10) Cross-sections of critical slope areas.

Such grading plan shall be reviewed by the HPR Board in relationship to adopted City policy on hillside grading;

(e) Proposed building plans, including floor plans and exterior elevations indicating the treatment of surfaces;

(f) Proposed plans for recreational facilities;

(g) Proposed parking plans;

(h) Proposed plot plans, showing building locations on each lot, building setbacks, and lot dimensions; and

(i) Where applicable, as a result of findings on site conditions and detailed site planning, supplemental information or modifications to the environmental impact statement prepared pursuant to the provisions of subsection (iii) of subsection (5) of subsection (a) of Section 9-4.2205 of this article. (Sec. 4.166, Ord. 363, as amended by Sec. 2, Ord. 69-C.S., eff. December 27, 1972)

Sec. 9-4.2209. Specific plans: Hearings: Commission action (P-D).

(a) The Commission may approve, approve conditionally, or disapprove the specific plans as presented. No developments shall be permitted in any P-D District, or any unit thereof, until the specific plans for such district, or unit thereof, have been approved or approved conditionally by the Commisssion.

(b) Prior to taking action on the specific plans submitted, the Commission shall conduct a public hearing in accordance with the procedures set forth in Section 9-4.3303 of Article 33 of this chapter.

(c) The owner or developer may submit specific plans for a portion or unit of the parcel zones P-D provided the development plan indicated the intention of the development of such parcel by units and established a time schedule for such development. (Sec. 4.167, Ord. 363).

Section 9-4.2210. Modification of regulations (P-D)

(a) Regulations for lot area, coverage, density, yard requirements, parking, building, height, fences, and landscaping for P-D Districts shall be as for the residential, commercial, or other zoning district most similar in nature and function to the proposed P-D District land uses, as determined by the Commission.

Such regulations may be modified, as provided in subsection (b) of this section, in any P-D District when the following conditions have been determined by the Commission to exist:

(1) There is improved site design utilizing progressive concepts of building groupings;

(2) Provision has been made for substantial usable open space (maximum slope ten (10%) percent) for the use of the occupants of the area or the general public;

(3) The insightliness of cut and fill areas has been reduced by the planting of trees, shrubs, and ground overs;

(4) A better community environment or improved public safety has been created by the dedicationof public areas or space; and

(5) Utility and all other service distribution lines will be put underground.

(b) Upon making the findings set forth in subsection (a) of this section, the regulations set forth in said subsection (a) may be modified up to the following limits:

(1) For each square foot of reduction in lot size, equal amounts of land shall be dedicated to the City and be improved for open spaces for park, recreation, and related uses to be permanently set aside for the private recreational use of the development under a plan which will assure the City of the continued availability of such land and the development and maintenance thereof for the purpose proposed.

(2) Front, side, and rear yards may be reduced to zero; provided however, where single-family dwellings are proposed and where no side yards are proposed (row houses), there shall be no more than five (5) dwelling units in any contiguous group. In such cases, the rear yard depths shall be twenty-five (25') feet except where the lot or lots abut a park or open space.

(3) The reduction of public rights-of-way and/or the requirement for the installation of sidewalks may be made subject to the requirement of providing comparable open space, as set forth in subsection (1) of this subsection.

(4) The gross population density and building intensity of any area proposed for development shall remain unchanged and conform to the basic overall density and building intensity requirements of the zoning district most closely conforming to the proposed development, as determined by the Commission. However, lot dimensions, building setbacks, and areas shall not be required to meet the specific requirements of this chapter provided a more functional and desirable use of the property is made.

(5) Height limitations may be removed, permitting high-rise construction, provided such additional stories of dwelling structures shall not increase gross population densities set forth in the approved development plan and such heights shall mean appropriate reduction in building coverage and adherence to the objectives set forth in this section and in Section 9-4.2252 of Article 22.5 of this chapter.
(Sec. 4.168, Ord. 363, as amended by Sec. 2, Ord. 69-C.S., eff. December 27, 1972)

Sec. 9-4.2211. Grading and excavation permits (P-D).

No grading or excavation permit shall be issued by the City for any location in a P-D District or Hillside Preservation District unless the permit has the approval of the Director of Community Development and the City Engineer who shall ensure that the issuance of the permit will not result in effects inconsistent with the purposes of this article or Article 22.5 of this chapter if such P-D District falls within the defined HPD. For a P-D District within the HPD District, the Director of Community Development and the City Engineer may, at their discretion, refer the permit to the HPR Board for its review. Approval of the permit shall be contingent upon the following conditions:

(a) The grading plan and work shall be directly related to an approved specific plan.

(b) Any grading and excavation shall be necessary for the establishment or maintenance of an approved specific plan.

(c) The design, scope, and location of the grading and excavation will cause minimum disturbance of the terrain and natural features of the land commensurate with the purpose of the grading and excavation work.

(d) All persons performing any grading and excavation operation shall put into effect all necessary safety precautions to minimize erosion, protect any watercourses and other natural features, protect the health and welfare of all persons, and protect private and public property from damage of any kind.

(e) The City shall place certain conditions on time limits and necessary site restoration, and shall undertake measures to assure fulfillment of such conditions, for any grading and excavation work.

(Section 2, Ord. 69-C.S., eff. December 27, 1972)

Article 22.5 HILLSIDE PRESERVATION DISTRICT (HPD)

Sec. 9-4.2250. Intent: Designation of Zoning Section Maps (HPD).

It is the intent of the Hillside Preservation District to place special controls on any proposed developments, public or private, within hillside areas of the City in order to:

(a) Preserve and enhance their use as a prime resource;

(b) Help protect people and property from potentially hazardous conditions due to grades and geology;

(c) Assure that any development be economically sound; and

(d) Encourage innovative design solutions.

The Hillside Preservation District is shown by the shaded areas on the Zoning Section Maps made a part of this chapter and shall be considered as an overlay district to the zoning districts incorporated within. In cases of conflict between such zoning districts and the overlay, Hillside Preservation District, the provisions of this article for the Hillside Preservation District shall prevail.

(Sec. 1, Ord. 69-C.S., eff. December 27, 1972)

Sec. 9-4.2251. Hearings and notices (HPD)

For any public hearing under the provisions and regulations of this article, the Commission shall give notice thereof by at least one publication in a newspaper of general circulation, published and circulated within the City, at least ten (10) days prior to such hearing and by mailing a postal card notice not less than ten (10) days prior to the date of the hearing to the owners of the property directly affected, and within a radius of 300 feet of the exterior boundaries of property directly affected, using for such purpose the last known name and address of such owners as shown upon the assessment roll of the County. The failure of any owner to receive such notice shall not invalidate the hearing proceedings.
(Sec. 1, Ord. 69-C.S., eff. December 27, 1972)

Sec. 9-4.2252. Purpose (HPD)

It shall be the purpose of the Hillside Preservation District to promote the following City objectives which shall be considered as guidelines:

(a) To maximize choice in types of environment available in the City and particularly to encourage variety in the development pattern of the hillsides;

(b) The concentration of dwellings and other structures by clustering and/or high rise should be encouraged to help save larger areas of open space and preserve the natural terrain;

(c) To use to the fullest current understanding of good civic design, landscape architecture, architecture, and civil engineering to preserve, enhance, and promote the existing and future appearance and resources of hillside areas;

(d) To provide density and land use incentives to aid in ensuring the best possible development of the City's natural features, open space, and other landmarks;

(e) To encourage the planning, design, and development of building sites in such a fashion as to provide the maximum in safety and human enjoyment while adopting development to, and taking advantage of, the best use of the natural terrain;

(f) To preserve and enhance the beauty of the landscape by encouraging the maximum retention of natural topographic features, such as drainage swales, streams, slopes, ridge lines, rock-out-croppings, vistas, natural plant formations, and trees;

(g) To prohibit, insofar as is feasible and reasonable, padding or terracing of building sites in the hillside areas;

(h) To provide a safe means of ingress and egress for vehicular and pedestrian traffic to and within hillside areas while at the same time minimizing the scarring effects of hillside street construction;

(i) Utility wires and television lines shall be installed underground;

(j) Outstanding natural physical features, such as the highest crest of a hill, natural rock-out-croppings, major tree belts, etc., should be preserved;

(k) Roads should follow natural topography wherever possible to minimize cutting and grading;

(l) Imaginative and innovative building techniques should be encouraged to create buildings suited to natural hillside surroundings; and

(m) Detailed and effective arrangements shall be formulated for the preservation, maintenance, and control of open space and recreational lands resulting from planned unit development.
(Sec. 1, Ord. 69-C.S., eff. December 27, 1972)

Sec. 9-4.2253. Hillside Preservation Review Board (HPR Board)

(a) Established. There is hereby established a Hillside Preservation Review Board for the City.

(b) Membership: Appointment. The Hillside Preservation Review Board shall consist of seven (7) members: two (2) registered architects; at least, but not limited to, two (2) persons who are expertise in any of the following fields: landscape architecture, civil engineering, geology, biology, real estate, or similar applicable areas of expertise; and three (3) citizens of the City representing the public at large. If it is not possible to fill the member positions of the architects and/or other fields of expertise, these positions shall be assumed by citizens at large. All members shall be appointed by the Mayor with the approval of the Council.

(c) Membership: Terms: Vacancies. Of the members of the Hillside Preservation Review Board first appointed, one shall serve for a term of one year, two (2) shall serve for a term of two (2) years, two (2) shall serve for a term of three (3) years, and two (2) shall serve for a term of four (4) years. Vacancies shall be filled by appointment for the unexpired portion of the term. The members first appointed shall draw lots to determine their individual terms under the staggered terms set forth in this subsdction.

(d) Membership: Terms: Limitations. All appointees to the Hillside Preservation Review Board shall serve not more than two (2) full consecutive terms on the Hillside Preservation Review Board and in no case more than eight (8) years.

(e) Membership: Appointment to other boards, committees, and commissions. Any appointee to the Hillside Preservation Review Board affected by the provisions of subsection (d) of this section may be appointed, upon the expiration of his term, to any other board, committee, or commission.

(f) Membership: Removal. The provisions of this article shall not be construed to limit the power of hte Council to remove any appointee to the Hillside Preservation Review Board by three (3) affirmative votes of the Council.

(g) Membership: Reappointment. Any appointee, upon the expiration of one year from the termination of his term, may be reappointed to the Hillside Preservation Review Board for not to exceed two (2) full additional consecutive terms.

(h) Purpose: Hillside Preservation Review Board. The HPR Board shall:

(1) Review and recommend to the Commission on all phases of hillside preservation and development policies as provided in Section 9-4.2252 of this article;

(2) Assist the staff in evaluating HPD development proposals;

(3) Review and conduct open meetings with the developer concerning such proposals at which the public is urged to participate; and

(4) Provide liaison with the Commission on HPD policies and proposals.
Sec. 1, Ord. 69-C.S., eff. December 27, 1972)

Sec. 9-4.2254. Scope (HPD).

Subject to all other regulations set forth in this chapter, uses shall be permitted and regulations shall apply in the Hillside Preservation District as set forth in this article.
(Sec. 1, Ord. 69-C.S., eff. December 27, 1972)

Sec. 9.4.2255. Uses permitted (HPD).

The uses permitted in the Hillside Preservation District shall be the uses designated on the approved development plan of the applicant and as such uses are consistent with appropriate and applicable elements of the adopted General Plan of the City, such as, but not necessarily limited to, land use, housing, open space, parks and recreationa, conservation, transportation, seismic safety, and any subsequent additions and changes to the General Plan and its elements as may be adopted by the City from time to time.
(Sec. 1, Ord. 69-C.S., eff. December 27, 1972)

Sec. 9.4.2256. Development procedures and standards (HPD).

Applicants of any development proposal within the Hillside Preservation District shall pursue the procedures and standards set forth for the P-D District, specifically Sections 9-4.2204 through 9-4.2211 of Article 22 of this chapter, as now enacted or hereafter amended. Public agencies including special districts, proposing developments and improvements on their lands within the HPD in conjunction with the uses and activities for which such lands are held shall be exempt from pursuing a P-D classification, but such developments and improvements shall adhere to the objectives of the HPD and specifically to the standards set forth in Sections 9-4.2258 of this article.
(Sec. 1, Ord. 69-C.S., eff. December 27, 1972)

Sec. 9-4.2257. Grading control (HPD).

No land over thirty-five (35%) percent slope prior to grading shall be developed except at the specific discretion of the City and taking into consideration the recommendations of the Hillside Presrvation Review Board and where it can be shown that a minimum amount of development is in the spirit of, and not incompatible with, the objectives of this article. In no case shall restrictions be placed which result in the use of such lands being unreasonably withheld. The following formula indicates those minimum percentages of the ground surface of a site which shall remain in a natural state (no cut or fill, but including recreation and landscape areas), or be developed solely for recreational purposes, based on the average percent slope of the parcel in question after the deduction of land over thirty-five (35%) percent slope. Access streets and driveways, but not including parking areas, may be given credit toward inclusion in the definition of "natural state" described above where it may be deemed beneficial to the City or where it can be shown that location and alignment requiring extensive runs of such streets and driveways cannot otherwise be practically altered.

The following formula is an acceptable method of determining average slope:

$$S = \frac{0.00229\ I\ L}{A}$$

Where S = Average percent slope of site, after deducting any portion of site of over 35% slope

I = Contour interval, in feet

L = Summation of length of contours, in feet

A = Area in acres of parcel being considered.

The minimum percent of site to remain in a natural state (no cut or fill but including recreation and landscape areas), or be developed solely for recreational purposes, shall be based on the following relationship:

$$U = 30 + (S - 5)^2$$

Where U = Percent of site to remain in condition as described above

S = Average percent slope of site, after deducting any portion of site of over 35% slope.

The following represents a graphic illustration of this formula:

In areas where the slope exceeds thirty-five (35%) percent and some development of such areas is deemed acceptable by the City, at least ninety (90%) of such lands should remain in uncovered area as described above, unless such restriction based on the topography would be confiscatory.

Notwithstanding the requirements for the minimum percent of the site shall remain in a natural state or be developed for, recreational purposes, it is recommended that a minimum of 100 square feet of usable recreational open space, as defined in Section 9-4.280 of Article 2 of this chapter, be provided for each dwelling unit. (Sec. 1, Ord. 69-C.S., eff. December 27, 1972)

Sec. 9-4.2258. Minimum street standards (HPD).

Minimum street standards in the Hillside Preservation District shall be as follows:

(Sec. 1, Ord. 69-C.S., eff. December 27, 1972)

Sec. 9-4.2259. Parking requirements (HPD).

Parking in the Hillside Preservation District shall be provided off-street, and in no cases may parking lanes be provided except as approved in a development plan. The intermittent widening of streets for emergency parking and turnarounds at convenient places shall be encouraged.

The following on-site parking standards shall be the minimum acceptable for residential units within hillside areas. The City may require more parking where topography, special traffic, building, grading, or other circumstances warrant it. The uncovered parking spaces may include areas such as driveways outside garages or carports and off-street parking bays, except that each required space shall be accessible at all times.

(a) Single-family detached dwelling units. Two (2) covered spaces, plus two (2) uncovered spaces. The uncovered spaces may be incorporated within a parking area shared by spaces for other units; provided, however, in no case shall the total number of spaces so located together be less than the same of the separate requirements for each unit and shall be located no farther than 100 feet from each dwelling unit entrance.

(b) Two and multiple-family dwelling units. For each dwelling unit, one covered space, plus one-half (1/2) uncovered space for each bedroom more than one in each unit. In cases where a one-half (1/2) space occurs in a total figure, the standard shall be increased to the next whole figure.

(c) Guest spaces. In addition to the standards set forth in subsections (a) and (b) of this subsection, a minimum of one guest space shall be provided for every ten (10) dwelling units, or fraction thereof.
(Sec. 1, Ord. 69-C.S., eff. December 27, 1972)

APPENDIX VIII-b--SOILS OVERLAY

EXCERPT

SOILS OVERLAY - MINE HILL, NEW JERSEY

8.600 CONSTRAINTS ON DEVELOPMENT BY SOIL TYPE

8.610 Purpose and Objective

The purpose of this section is to prevent inappropriate development from taking place in Mine Hill Township in those areas characterized by certain soil types, slopes and water levels without proper corrective action if possible. Inappropriate development in these areas increase soil erosion and sedimentation thereby intensifying flooding by clogging drainage structures. Sedimentation reduces reservoir life and destroys the recreational use of water bodies.

Inappropriate development on certain soils permits the introduction of toxic materials into water aquafiers and encourage pollution. It destroys ecological and natural resources to the detriment of the Township and region. It requires expenditures of public funds to correct deficiencies. Inappropriate development destroys the taxable value of property by causing damage to the environmental character of the land.

8.620 Soils Map and Other Data

The Soil Survey Map of the Morris County Soil Survey shall govern as to the type of soil in a particular area. Applicant shall submit current soil logs and topographic surveys to support development proposals or to update Soil Survey data.

8.630 Soil Limitations

Soil limitations by soil code is contained in Schedule V following:

SCHEDULE V

Soil Code	Problems and Development Limitations
0131/A-12	Unbuildable, flood plain
1017/BC-15	Moderate erosion, severe limitations on ponds and athletic fields
1017/D-15	Unbuildable, slopes in excess of 15 percent
101B/BC-15	Moderate erosion, severe limitations on ponds, athletic fields, woods and grading
101B/D-15	Unbuildable, slopes in excess of 15 percent
101B/EF-15	Unbuildable, slopes in excess of 25 percent
101R/EF-15	Unbuildable, slopes in excess of 25 percent

Soil Code	Problems and Development Limitations
1317/B-12	No specific problems
1317/C-3	Severe erosion; special soil erosion and sedimentation controls required
1317/C-12	Moderate problems generally, severe limitations on ponds, parking areas, athletic fields
1317/D-12	Unbuildable, slopes in excess of 15 percent
1417/B-12	No specific problems
1427/B-12	Poor drainage, high water table, brief ponding, generally severe development problems
1X37/B-12	Same as above with occasional flooding, generally severe development problems
1X29/B-15	Poor drainage, brief ponding, moderate erosion problems, low density of development
1X29/C-15	High erosion problems, generally severe development problems
1X39/B-15	High water table, brief ponding, generally severe development problems
1X39/C-15	Same as above
2X19/BC-15	Extremely rocky, generally severe development problems
2X19/D-15	Unbuildable, slopes in excess of 15 percent
2X19/EF-15	Unbuildable, slopes in excess of 25 percent
B313/B-12	No specific problem
B323/B-12	High water table, brief ponding, generally moderate development problems
B233/A-12	Very high water tables, severe development problems
U21N/B	Generally moderate development problems
Z21N/B	No data available, requires individual analysis
Z21N/D	Unbuildable, slopes in excess of 15 percent
Z21N/C-12	No data available, requires individual analysis
Z23/B	No data available, requires individual analysis

8.640 Application of Schedule V

Applicants shall not place structures or construct improvements on those lands indicated in Schedule V as unbuildable. Areas indicated as having severe development problems should be avoided unless corrective action is indicated such as soil erosion and sedimentation control measures, storm drainage systems, rip-rap and retaining walls, fill,excavations and other appropriate improvements.

Applicants for PUD, GA, commercial or industrial development, and major subdivisions of single-family homes may develop to the permitted density and coverage using good design techniques such as clustering to avoid development on soils indicated as unsuitable for development or having severe problems in Schedule V.

APPENDIX VIII-c--GUIDING PRINCIPLES

DRAFT

ALTERNATIVE #1

BOISE, IDAHO PROPOSAL

PURPOSE:

The purpose of this ordinance shall not be to preclude development but to ensure that development enhances rather than detracts from or ignores the natural topography, resources and amenities of the hillsides. To this end, the following points shall serve as a basis for evaluating all hillside development proposals.

1. All development proposals shall strive for maximum retention of the natural morphological features and qualities of the site and development shall seek to enhance these natural features and qualities.
2. All development proposals shall take into account and shall be judged by the application of current understanding of land use planning, soil mechanics, engineering geology, hydrology, civil engineering, environmental and civic design, architecture and landscape architecture in hill areas. Such current understanding includes but is not limited to:
   a. Planning of development to fit the topography, soils, geology, hydrology and other conditions existing on the proposed site;

   b. Orienting development to the site so that grading and other site preparation is kept to an absolute minimum;

   c. Shaping of essential grading to compliment the natural land forms and prohibiting all successive padding and/or terracing of building sites;

   d. Developing large tracts in workable units on which construction can be completed within on construction season so that large areas are not left bare and exposed during the winter-spring runoff period;

   e. Accomplishing all paving as rapidly as possible after grading;

   f. Allocating to open space and recreation uses those areas not well suited to development, as evidenced by competent soils, geology and hydrology investigations and reports;

   g. Landscaping of areas around structures and blending them with the natural landscape;

   h. Placement, grouping and shaping of man-made structures to complement one another and the natural landscape, providing visual interest, and creating a "sense of place" within the development;

i. **Demonstrating a concern for the view _of_ the hills as well as the view _from_ the hills;**

j. **Use of a variety of housing types in residential areas to permit steep slopes, wooded areas, and areas of special scenic beauty to be preserved as scenic easements, through the use of density tranfers; such alternatives may include attached dwellings apartments and condonominiums, residential clusters and groups of various housing types;**

k. **Special consideration in the design of such visual elements as street lighting, fences, sidewalks, pathways and other street "furniture" to enable maximum identity and uniqueness of character to be built into each development;**

l. **Minimizing disruption of existing plant and animal life.**

1.03 SPECIAL REQUIREMENTS AND DESIGN STANDARDS:

1. Project Engineer

To ensure the necessary coordination of manpower and technical data, the developer shall retain a professional engineer registered in the State of Idaho, to serve as the project engineer.

a. It shall be the responsibility of the project engineer:

   i. To prepare a grading plan (see Section 12.036);

   ii. To incorporate into the grading plan all recommendations contained in the soils, geology and hydrology reports (see sections 12.032-12.034);

   iii. To inspect and certify all grading operations within his area of technical specialty;

   iv. To act as coordinating agent if the need arises for liaison between other professionals, the developer and the Commission;

   v. To prepare any revised plans and to submit to the Commission as-graded grading plans upon the competion of the plan.

b. Prior to and during grading operations, all necessary reports, compaction data, soils, geology and hydrology recommendations shall be submitted to the project engineer and to the Commission;

c. If, in the course of fulfilling their responsibilities, the project engineer, soils engineer, geologist or hydrologist discovers that the work is being accomplished to a substantially lesser standard than required by this Ordinance or by the approved final grading plan, the discrepancy, if not corrected within a reasonable time shall be reported immediately, in writing, to the project engineer and to the Commission. Recommendations for corrective measures, if applicable, shall be submitted;

d. If the project engineer, the soils engineer, the geologist or the hydrologist of record is changed during the course of the work, the work shall be stopped until the placement has agreed to accept the responsibility for certification of the work within the area of his technical competenence.

2. Soils Report

a. Any area proposed for development shall be investigated to determine the soil characteristics, and a soils engineering report shall be submitted with every application. This report shall include data regarding the nature, distribution and strength of existing soils, conclusions and recommendations for grading procedures, design criteria for corrective measures, and opinions and recommendations covering the adequacy of sites to be developed;

b. The investigation and subsdquent report shall be completed and presented to the Commission by a professional engineer registered in the State of Idaho, and experienced and knowledgeable in the practice of soils mechanics;

c. Recommendations included in the report and approved by the engineer shall be incorporated into the design plan or specifications;

d. Any area which presents one or more of the following limiting factors shall not be subjected to development unless the engineer can demonstrate conclusively to the Commission that these limitations can be overcome in such a manner as to prevent hazard to life, hazard to property, adverse affects on the safety, use or stability of a public way or drainage channel, and adverse impact on the natural environment;

i. Water table within six (6) feet of the surface at any time of the year;

ii. Natural slopes greater than 15 percent;

iii. Soils with a high shrink-swell potential, that is, soils where the co-efficient of linear extensibility (COLE) is equal to or greater than 0.06, or where the Potential Volume Change (PVC) (as used by the Federal Housing Administration) is equal to or greater than 4;

iv. Soils with a Unified classification of CH, MH, OL, OH, or PT.

3. Geology Report

a. Any area proposed for development shall be investigated to determine its geological characteristics and a geology report shall be submitted with every application. This report shall include an adequate description, as defined by the Commission, of the geology of the site, conclusions and recommendations regarding the effect of geologic conditions on the proposed development, and opinions and recommendations of the adequacy of the sites to be developed.

b. The investigation and subsequent report shall be completed and presented to the Commission by a professional geologist registered in the State of Idaho, and experienced and knowledgeable in the practice of engineering geology;

c. Any area in which the investigation indicates geological hazards shall not be subjected to development unless the geolgoist can demonstrate conclusively to the Commision that these hazards can be overcome in such a manner as to prevent hazard to life or limb, hazard to property, adverse affects on the safety, use or stability of a public way or drainage channel, and adverse impact on the natural environment.

4. Hydrology Report

a. Any area proposed for development shall be investigated to determine its hydrological characteristics, and a hydrology report shall be submitted with every application. This report shall include an adequate description, as defined by the Commission, of the hdryology of the site, conclusions and recommendations regarding the effect of hydrologic conditions on the proposed development, and opinions and recommendations covering the adequacy of sites to be developed;

b. The investigation and subsequent report shall be completed and presented to the Commission by a qualified registered professional experienced and knowledgeable in the science of hydrology and in the techniques of hydrologic investigation;

c. Any area in which the investigation indicates hydrological hazards shall not be subjected to development unless the developer can demonstrate conclusively to the Commission that these hazards can be overcome in such a manner as to prevent hazard to life or limb, hazard to property, adverse affects on the safety, use of stability of a public way or drainage channel, and adverse impact on the natural environemnt;

d. Flood frequency curves shall be provided for the area proposed for development.

5. Hydrologic Controls

If the developer can demonstrate conclusively to the Commission that any of the following requirements, "a" through "l", are not necessary in the proposed subdivision and that the omission of such requirement(s) would not result in hazard to life or limb, hazard to property, adverse affects on the safety, use or stability of a public way or drainage channel or adverse impact on the natural environment, the Commission may waive those particular requirements.

a. Interceptor ditches shall be established above all cut/fill slopes and the intercepted water conveyed to a stable channel or natural drainageway with adequate capacity;

b. Curb, gutter and pavement design shall be such that water on roadways is prevented from flowing off the roadway in an uncontrolled fashion;

c. Natural drainageways shall be riprapped or otherwise stabilized below drainage and culvert discharge points for a distance sufficient to convey the discharge without channel erosion;

d. Runoff from areas of concentrated impervious cover (e.g., roofs, driveways, roads) shall be collected and transported to a natural drainge with sufficient capacity to accept the discharge without undue erosion;

e. Waste material from construction, including soil and other solid materials, shall not be deposited within the 100 year flood plain;

f. Drainageways, or hydrologically related structures in major waterways (major waterways defined as draining an area of ten acres or more) shall be designed for the 100 year exceedance interval; in minor waterways (minor waterways defined as draining an area of less than ten acres) they shall be designed for the 25 year exceedence interval;

g. With the exception of unavoidable raod crossings, approved drainage structures, recreation and open space uses which do not involve the destruction of vegetal cover, development shall not be prohibited within the 100 year exceedence interval flood plain for major waterways, and the 25 year exceedence interval flood plain for minor waterways;

h. Sediment catchment ponds shall be constructed and maintained downstream from each development, unless sediment retention facilities are otherwise provided;

i. The overall drainage system shall be completed and made operational at the earliest possible time during construction;

j. Alterations of major drainageways shall be prohibited except for approved road crossings and drainage structures;

k. Natural or improved open channel drainageways shall be preserved or provided for in major waterways. Only minor waterways shall be permitted to be enclosed in conduits, except for road crossings;

l. The Commission shall reserve the right to install hydrological measuring devices in drainageways within any development, at public expense.

6. Grading

a. A grading plan shall be submitted with each application and shall include the following information:

   i. All information required by this Ordinance;

   ii. Details and contours (5 foot intervals) of property:

   iii. Details of terrain and area drainge;

   iv. Location of any existing buildings or structures on the property where the work is to be performed, the location of any existing buildings or structures on land of adjacent owners which are within one hundred (100) feet of the property or which may be affected by the proposed grading operations, and proposed or approximate locations of structures relative to adjoining topography;

   v. The direction of drainge flow and the approximate grade of all streets. (Not to be construed as a requirement for final street design);

   vi. Limiting dimensions, elevations or finish contours to be achieved by the grading, including all cut and fill slopes, proposed drainage channels and related construction;

   vii. Detailed plans and locations of all surface and subsurface drainge devices, walls, dams, sediment basins, storage reservoirs and other protective devices to be constructed with, or as a part of, the proposed work, together with a map showing drainage area, the complete drainage network, including outfall lines and natural drainageways which may be affected by the proposed development and the estimated runoff of the area served by the drains;

   viii. A description of methods to be employed in disposing of soil and other material that is removed from the grading site, including the location of the disposal site;

   ix. A schedule showing when each stage of the project will be completed, including the total area of soil surface which is to be disturbed during each stage, and estimated starting and completion dates; the schedule shall be drawn up to limit to the shortest possible period the time that soil is exposed and unprotected. In no event shall the existing ("natural") vegetation ground cover be destroyed, removed or disturbed more than 15 days prior to grading or construction of required improvements.

c. The grading plan shall be prepared by a professional engineer registered in the State of Idaho who shall also serve as the overall project engineer;

d. The Commission may require that grading operations and/or project designs be modified if delays occur which incur weather generated problems not considered at the time approval was granted;

e. The Commission may require on-site inspections at any point during the development period to ascertain compliance with the approved grading plan and the applicable provisions of this ordinance.

1.04 DEVELOPMENT STANDARDS:

This section shall apply to all construction other than roadways.

1. No grading, filling, clearing or excavation of any kind shall be initiated until the final grading plan is formally approved by the Commission;

2. Fill areas shall be prepared by removing organic material, such as vegetation and rubbish, and any other material which is determined by the soils engineer to be detrimental to proper compaction or otherwise not conducive to stability; no rock or similar irreducible material with a maximum dension greater than 8 inches shall be used as fill material in fills that are intended to provide structural strength.

3. All retaining walls or facings with a total vertical projection in excess of 3 feet and associated with cut or fill surfaces shall be designed as stuctural members keyed into stable foundations and capable of sustaining the design loads.

   If the developer can demonstrate conclusively to the Commission that any of the following requirements are not necessary in the proposed subdivision and that the omission of such requirements would not result in hazard to life or limb, hazard to property, adverse effects on the safety, use or stability of a public way or drainage channel, or adverse impact on the natural environment, the Commission may waive those particular requirements;

4. Fills shall be compacted to at least 95% of maximum density, as determined by AASHO T99 and/or ASTM D698;

5. Natural or constructed slopes in excess of 15% shall not be subjected to development;

6. Cut slopes shall be no steeper than two (2) horizontal to one (1) vertical; subsurface drainage shall be provided as necessary for stability;

7. Fill slopes shall be no steeper than two (2) horizontal to one (1) vertical; fill slopes shall not be located on natural slopes 2:1 or steeper, or where fill slope toes out within 12 feet horizontally of the top of an existing or planned cut slope;

8. Tops and toes of cut and fill slopes shall be set back from property boundaries a distance of 3 feet plus one-fifth of the height of the cut or fill but need not exceed a horizontal distance of 10 feet; tops and toes of cut and fill slopes shall be set back from structures a distance of 6 feet plus one-fifth the height of the cut or fill, but not exceed 10 feet;

9. Borrowing for fill shall be prohibited unless the material is obtained from a cut permitted under an approved grading plan obtained for some purpose other than to produce fill material, or imported from outside the hillside areas within Ada County;

1.05 ROADWAYS:

Ada County Highway District standards, with certain additions and modifications, shall apply to all roadways constructed under this Ordinance. Those additions and modifications are as follows:

1. No grading, filling, clearing or excavation of any kind shall be initiated until the final roadway grading plan is formally approved by the Commission and the Ada County Highway District;

2. Fill areas shall be prepared by removing organic material, such as vegetation and rubbish, and any other material which is determined by the soils engineer to be detrimental to proper compaction or otherwise not conductive to stability;

3. All retaining walls or facings with a total vertical projection in excess of 3 feet and associated with cut or fill surfaces shall be designed as structural members keyed into stable foundations and capable of sustaining the design loads;

4. Borrowing for fill shall be prohibited unless the material is obtained from a cut permitted under an approved grading plan, or imported from outside the hillside areas within Ada County;

5. Roads shall be designed to create the minimum feasible amounts of land coverage and the minimum feasible disturbance to the soil;

6. Existing vegetation of the deep-rooted perennial variety shall be preserved to the greatest extent possible in the location of roads. Road alignment should follow natural terrain and no unnecessary cuts or fills shall be allowed in order to create additional lots or building sites;

7. Variations in rights-of-way standards shall be permitted to prevent the dedication of unnecessarily large parcels of land;

8. Variations in road design and road construction shall be permitted in order to keep grading and cut-fill slopes to a minimum;

9. Roads shall not exceed two (2) lanes with a traveled way which shall not exceed thirty-two (32) feet in width, exclusive of on-street parallel parking bays as allowed under Section 12.06, 4;

10. One-way streets shall be permitted and encouraged where appropriate for the terrain and where public safety would not be jeopardized. The traveled way shall not exceed sixteen 16) feet in width, exclusive of on-street parallel parking bays as allowed under Section 12.06, 4;

11. The width of the graded section shall extend three (3) feet beyond the curb back or edge of pavement on both the cut and fill sides of the roadway. If sidewalk is to be installed parallel to the roadway, the graded section shall be increased by the width of the sidewalk plus one foot beyond the curb back.

12. Standard vertical curb (six inches) and gutter shall be installed along both sides of all paved roadways;

13. A pedestrian way plan shall be required in all developments. The location and design shall require the approval of the Commission and, where appropriate, the Ada County Highway District.

    If the developer can demonstrate conclusively to the Commission and the Ada County Highway District that any of the following requirements are not necessary in the proposed subdivision and that the omission of such requirements would not result in hazard to life or limb, hazard to property, adverse affects on the safety, use or stability of a public way or drainage channel, or adverse impact on the natural environment, the Commission may waive those particular requirements;

14. Natural slopes in excess of 15% shall not be subjected to development;

15. Cut slopes shall be no steeper than two (2) horizontal to one (1) vertical; subsurface drainage shall be provided as necessary for stability;

16. The maximum horizontal distance of disturbed soil surface shall not exceed seventy-five (75) feet;

17. Fill slopes shall be no steeper than two (2) horizontal to one (1) vertical; fill slopes shall not be located on natural slopes steeper than 2:1 or where fill slope toes out within 12 feet horizontally of the top of an existing or planned cut slope;

18. Tops and toes of cut and fill slopes shall be set back from buildings a horizontal distance of 6 feet plus one-fifth the height of the cut of fill, but need not exceed 10 feet;

19. Fills shall be compacted to at least 95% of maximum density, as determined by AASHO T99 or ASTM D698;

20. All slopes which are stabilized by mechanical or chemical restraints shall be adapted to conform to the surrounding terrain and shall be given proper aesthetic treatment.

1.06 DRIVEWAYS AND OTHER PARKING:

1. Combinations of collective private driveways, cluster parking areas and on-street parallel parking bays shall be used to attempt to optimize the objectives of minimum soil disturbance, minimum impervious cover, excellence of design and aesthetic sensitivity;

2. Collective private driveways shall be encouraged where their use will result in better building sites and lesser amounts of land coverage than would result if a public road were required;

3. Cluster parking areas shall be encouraged where they will not result in drastic increases in the amount of impervious cover and/or where they might eliminate private individual parking;

4. On-street parallel parking bays shall be encouraged where considerations of terrain or aesthetic quality would reduce the desirability of collective driveways or cluster parking;

1.07 VEGETATION AND REVEGETATION:

1. The developer shall submit a slope stabilization and revegetation plan which shall include a complete description of the existing vegetation, the vegetation to be removed and the method of disposal, the vegetation to be planted, and slope stabilization measures to be installed. The plan shall include an analysis of the environmental effects of such operations, including the effects of such operations, including the effects on slope stability, soil erosion, water quality and fish and wildlife;

2. The revegetation and slope stabilization plan shall be submitted with the grading plan;

3. Vegetation shall be removed only when absolutely necessary, e.g., for buildings, filled areas, roads;

4. Every effort shall be made to conserve topsoil which is removed during construction for later use on areas requiring vegetation or landscaping, e.g., cut and fill slopes;

5. Vegetation sufficient to stabilize the soil shall be established on all disturbed areas as each stage of grading is completed. Areas not contained within lot boundaries shall be protected with adapted, fire-resistant species of perennial vegetal cover after all construction is completed, (a list of such species is available in the office of the Planning Administration);

6. New Plantings shall be protected with organic cover;

7. All disturbed soil surfaces shall be stabilized or covered prior to the first day of December. If the planned impervious surfaces (e.g., roads, driveways, etc.) cannot be established prior to December 1, a temporary treatment adequate to prevent erosion shall be installed on those surfaces;

8. Construction shall be scheduled to minimize soil disturbance between the first day of December and the fifteenth day of April;

9. The developer shall be fully responsible for any destruction of native vegetation proposed for retention He shall carry the responsibility both for his own employees and for all subcontractors from the first day of construction until the notice of completion is filed. The developer shall be responsible for replacing such destroyed vegetation;

10. The use of qualified personnel experienced and knowledgeable in the practice of revegetation shall be required.

1.08 MAINTENANCE:

The owner of any private property on which grading or other work has been performed pursuant to a grading plan approved or a building permit granted under the provisions of this Ordinance shall continuously maintain and repair all graded surfaces and erosion prevention devices, retaining walls, drainage strctures or means, and other protective devices, plantings and ground cover installed or completed.

1.09 UTILITIES:

All new service utilities, both on-site and off-site, shall be placed underground.

1.10 OBJECTS OF ANTIQUITY:

1. No grading, filling, clearing or vegetation, operation of equipment, or disturbance of the soil shall take place in areas where any historic or prehistoric ruins or monuments, objects of antiquity, or geological landmarks or monuments are present. The grading plan shall indicate all such areas on the site and shall indicate the measures that will be taken to protect such areas. The Idaho State Historical Society shall approve the proposed protection measures before the grading plan is approved;

2. Whenever during excavation there are uncovered or become apparent any historic or prehistoric ruins or monuments, or objects of antiquity, or geological landmarks or monuments not previously accounted for in the grading plan, all work in the immediate area shall cease until the Idaho State Historical Society shall determine what precautions should be taken to preserve the historic artifacts.

1.11 REQUEST FOR WAIVER OR REQUIREMENTS:

If the developer intends to request waiver of any of the provisions of Section 1.00, he must submit his request, in writing, with his grading plan. The request shall itemize each requirement for which a waiver is sought and shall state the reason(s) for which each waiver is requested.

GLOSSARY

Aquifer	A body of rock or soil that contains sufficient saturated permeable material to conduct groundwater and to yield economically significant quantities of groundwater to wells and springs.
Artesian	Refers to water confined under pressure.
Biome	A major biotic community including all plant and animal life, e.g., the North American boreal forest, European deciduous forest.
BOD--Biochemical Oxygen Demand	The amount of dissolved oxygen used up in decomposition of organic matter in water. If the amount of oxygen dissolved in water is high then BOD is low, and visa versa.
Boreal forest	The forest extending across northern North America, consisting chiefly of conifers.
Channel geometry	Description of the shape of a given cross-section of a river channel.
Chemical weathering	Chemical reactions such as hydrolysis, or oxidation, by which rocks and minerals are broken down into soil.
Clay	1. The smallest mineral particles in soil, less than .002 mm. in diameter. 2. Soil that contains at least 40 per cent clay particles, less than 45 per cent sand, and less than 40 per cent silt.
Clear cutting	The felling of all trees in an area at one time.
Climax stage	The terminal state of succession at which a community can perpetuate itself and maintain a nonchanging composition of plant and animal life, determined by environmental conditions, climate, soil type, drainage, etc.
Coliformbacteria	Non-harmful microorganisms (excherichia coli), used to indicate the possible presence of disease causing bacteria in water; found in human and animal feces.

Confined aquifer
An aquifer bounded above and below by beds of distinctly less permeable material than the aquifer itself.

Coniferous
Refers to a conifer, which is any plant of the order Coniferales, having needle-like leaves and seeds born in cones, e.g., pine, spruce, fir.

Consolidated
Refers to earth materials whose particles are cemented together and that are firm and coherent.

Creep
The slow, downward mass movement of ice, soil, or rock on a slope.

Cut and fill
The excavating of material in one place and depositing of it as fill in an adjacent place.

Deciduous
Refers to the loss of parts of an organism, such as leaves of a tree, occurring at certain seasons.

Discharge (Stream)
Rate of flow of a stream expressed as volume per unit of time.

Discharge area (Groundwater)
An area in which subsurface water is released to the land surface.

Diversity (ecological)
Variety of species of plants and animals that compose a biotic community or ecosystem; often expressed as total number of different species.

Drainage pattern
The arrangement of the natural stream courses in an area.

Ecotone
The transitional zone between two distinct biotic communities (usually biomes), characterized by a mixture of plant and animal species of the two communities and with characteristics of its own.

Edge effect
The influence of two communities upon their border, whereby composition, density, and diversity are affected, usually being more complex and greater than the two distinct communities (e.g., grassland bordering a woodland).

Emergent vegetation

Refers to aquatic vegetation, rooted in but protruding above the water, e.g., cattails.

Erosion

The process by which the soil and rock components of the earth's crust are worn away and removed from one place to another by natural forces such as weathering, solution, and transportation.

Estuary

An arm of the sea at the mouth of a river where the current of the river meets the tide and where salt and fresh waters mix.

Eutrophication

The process by which bodies of water become enriched with mineral and nutrients and organic materials, often algae proliferates, dissolved oxygen decreases and deposited dead material causes shallowing. Often accelerated by discharge of sewage or overland runoff of fertilizers.

Evaporation

With regard to the hydrologic cycle, the loss of water from surface water to the atmosphere.

Food chain

Refers to the dependence for food of organisms upon each other in a series, beginning with plants and ending with the largest carnivores.

Food web

The combination of all of the food chains in a community.

Gravel

Large soil particles 2 to 20 mm. in diameter or an unconsolidated, natural accummulation of rounded rock particles.

Ground layer

The plants, living or dead, on the surface of the ground.

Gully erosion

Erosion of soil or soft rock material by running water that forms relatively large, distinct, narrow channels.

Herbivore

An organism that eats plants.

Hydrologic cycle

The cycle of the movement of water from the atmosphere by precipitation to the earth and its return to the atmosphere by interception, evaporation.

Hydrology
The properties of the water, including circulation and distribution, on and below the ground.

Impervious
Incapable of transmitting fluids.

Infiltration
The penetration of water into soil or other material.

Leachate
A toxic or obnoxious fluid produced by water percolating through a waste or chemical-storage deposit.

Leaching
The removal of certain components of the soil by percolating water.

Microclimate
The climatic conditions of a relatively small area or habitat (e.g., the inside of a hollow log or the north side of a hill).

Monoculture
The existence of many individuals of one plant or animal species without other species interspersed as under natural conditions, e.g. a corn field or a white-pine plantation.

Niche
The sum of the relationships that a species has with the rest of the system within which it exists; what it eats, how, and when; what temperature it prefers; what plants it uses for cover; what kind of soil pH it grows in, etc.

Organic matter (in soil)
Material derived from plants and animals, as opposed to minerals, much of it in a more or less advanced stage of decomposition.

Outcrop
A geologic layer exposed at the earth's surface.

Overdraft
Withdrawal of groundwater in excess of replenishment.

Permeability
The property of soil or rock that refers to the ease with which water or air may pass through the material.

Pest species
A plant or animal that is prolific beyond natural control. Usually introduced, it outcompetes plant and animal species found under natural conditions.

Physical or mechanical weathering
The process of weathering by which physical forces such as frost action and wind break down or reduce rock to smaller fragments.

Physiographic province
A region, all parts of which are similar in geologic structure and climate and which consequently has a unified geomorphic history.

Pioneer species
A plant or animal that first appears on a bare or freshly disturbed area.

Predator
An animal that attacks and eats other animals.

Recharge area
An area in which water is absorbed and added to the groundwater reservoir.

Relic species
A remnant species or group of species that was widespread in an area during a former period of different climatic conditions.

Runoff
That part of precipitation that flows off the land without filtering into the soil.

Salt water intrusion
Displacement of fresh surface or groundwater by the advance of sea water, sometimes caused by overdraft of a well.

Sand
1. Large size particles in soil from .5 to 2 mm. in diameter. 2. A soil that contains at least 85 per cent sand with the percentage of silt plus 1.5 times the percentage of clay not exceeding 15.

Scour
The clearing and digging action of flowing air or water, especially the downward erosion by stream water in sweeping away mud and silt on the outside of a curve or during a flood.

Second growth
A forest which comes up after the removal of the old stand by cutting, fire, etc.

Sedge

A grasslike plant in appearance of the family Cyperaceae, often with a triangular base.

Sedimentation

The process of depositing materials from a liquid, especially in bodies of water.

Sediment load

The quantity of solid material that is transported by a natural agent, such as a stream and expressed as a dry weight passing a given point in a given period of time.

Sediment transport

The movement of sediment by natural agents such as runoff or surface watercourses.

Selective cutting

The felling of certain trees in an area, such as the largest ones.

Shrub

A perennial woody plant that differs from a tree by its low growth and multiple stems.

Silt

1. Intermediate sized particles in soil from .002 mm. to .5 mm. in diameter. 2. Soil that contains at least 80 per cent particles and less than 12 per cent clay.

Slide

The downhill mass transit movement of soil, rock, or snow resulting from failure of that material under stress.

Slip

The downhill movement for a short distance of a mass of wet or saturated soil.

Slope

The inclination of the surface of the land from the horizontal

0-3.0 degrees	(0-5%) level
3.0--8.5 degrees	(5--15%) gentle
8.5-16.5 degrees	(15--30%) moderate
16.5-26.5 degrees	(30--50%) steep
26.5-45 degrees	(50-100%) very steep
greater than 45 degrees	(greater than 100%) precipitous

Subsidence

Gradual downward, local, mass movement of the earth's surface.

Succession

The progression or gradual replacement of one kind of biotic community by another, the compositions of which overlap in the process; the progression from pioneer to climax stage.

Topography

General term to include characteristics of the ground surface such as plains, hills, mountains; degree of relief, steepness of slopes, and other physiographic features.

Transpiration

The release of water vapor from plants to the atmosphere.

Trophic level

One part of the food chain which consists of five trophic levels:

Producers.	Green plants
Hervivores	Plant eaters
Primary carnivores . . .	Herbivore eaters
Secondary carnivores. .	Primary carnivore eaters
Decomposers.	Fungi and bacteria that breakdown all dead plants and animals

Turbidity

The cloudy condition of a body of water that contains suspended material such as clay or silt particles, dead organisms, or small living plants or animals.

Unconfined aquifer

An aquifer having a water table.

Unconsolidated

Refers to earth materials whose particles are not cemented together and that are loosely arranged.

Understory

The trees in a forest below the canopy, usually younger.

Virgin forest

Refers to a woodland essentially uninfluenced by human activity.

Watershed

The region drained by or contributing water to a stream, lake, or other body of water.

Water table

The upper surface of the free groundwater in a zone of saturation except when separated by an underlying of groundwater by unsaturated material.

Weathering

The process of disintegration of rocks and minerals at or near the earth's surface, whereby they are changed in character.

Weed

General term for any troublesome or undesirable plant; once introduced, it generally outcompletes native plant species.

Sources: Hanson, Herbert Christian, Dictionary of Ecology. New York, 1962

Gary, Margaret, Robert McAfee Jr., and Carol L. Wolf, editors, Glossary of Geology. Washington, D.C., 1972

APPENDIX A

ENVIRONMENTAL PERFORMANCE STANDARDS

A. The Nature and Character of Environmental Performance Standards

The work of translating what is known about the interrelationships of land use and environmental protection into land control programs has concentrated on the traditional specification standards with this method, the desired pattern of activities is determined by specifying locations and development standards through zoning, subdivision controls, building codes, and other devices. Specification standards indicate what one can or cannot do based on the existence of a feature of a combination of features. For example, since the integrity of the floodplain must be maintained to protect lives and to store excess water, no development should be allowed. Since aquifer recharge areas are needed to replenish ground water supplies, no paving should be permitted. Since steep slopes may slip, only low density housing is allowed. The orientation is one of controlling man-made features rather than one of protecting environmental functions or processes.

The use of specification standards to make development more compatible with environmental features has been worthwile; however, if experience with other regulatory systems is any guide, there are inherent advantages in moving away from specification standards toward performance standards. Building codes which specify what material is to be used for a wall, restrict innovation. However, a building code using performance standards will indicate how the wall should perform, in terms of fire resistance, sound absorption, load bearing capacity, etc. In short, the specification code tends to stifle technological progress while the performance code tends to encourage it. A performance code eliminates the need for the drafters of the code to know about and test all available materials and processes. The burden of proof is shifted to the proponents of the new material or process, who must prove that it does perform as required. Performance standards are concerned with output (results) and not with input (the type of material used). It is the output that is the real issue.

Early zoning ordinances were (and must remain) strictly specification standards. They consisted of long "use" lists and maps which specified, for instance, that a steel mill was a heavy industry and an electronics assembly plant a light one, and that each had to go into an appropriate zone. This kind of ordinance required the drafters to list all types of present and (if possible) future uses, and then decide which ones were heavy and which ones were light. Needless to say the task was difficult and frequently resulted in arbitrary decisions.

In the 1950's ASPO developed a concept of industrial performance standards for zoning ordinances. The idea was that it really didn't matter what use went where, but what mattered was how that use performed. The performance criteria were in terms of such measurable outputs as air pollution, noise, vibration, glare, etc. Thus, a steel mill that for some reason "performed" as a clean, quiet industry would be permitted near residential uses (ignoring for the moment other criteria such as traffic generation). On the other hand, an electronics assembly plant that, for some reason, generated air pollution above a specified amount or noise greater than so many decibels would be segregated from incompatible uses. What mattered was performance or process (amount of pollution generated) rather than the fact that a particular product happened to be produced at that site (steel or transistors).

The entire history of zoning and land regulations, generally, has been one in which there has been a slow but steady movement toward replacing specification codes with performance codes. Such techniques as planned unit development, floating zones, special use permits, market feasibility studies, as well as industrial performance standards have all been attempts to regulate a particular use or activity on the basis of its performance. This is in contrast to the earliest ordinances which were simply maps that attempted to specify in advance not only where every single possible use could locate, but also its density, height, bulk, materials, and, in some cases, construction procedures.

The history of environmentally oriented land use regulations have essentially followed the same pattern as building codes and industrial zoning.

The goal of environmentally oriented land use regulations, such as those discussed in this manual, is to maintain or preserve natural processes as land undergoes change for man's use. Under traditional Euclidian zoning, this goal is implemented by listing land uses that are likely to have heavy impact on the natural processes such as runoff, or infiltration, or erosion and those uses which are likely to have less impact. Then the natural resource functions of the land are protected by zoning environmentally sensitive areas for those particluar uses which will have the least impact. In practice, this approach has essentially identified buildable and unbuildable land. Environmentally sensitive areas are zoned for those uses that do not require extensive construction--such as agriculture, recreation, and conservation uses, while less sensitive areas provide land for residential, commercial, and industrial uses. Where building is permitted, it is regulated by specifying requirements for drainage tiles or culverts or retaining structures which will minimize the problems arising from development.

Specifying land uses is, however, only a crude implementation of the goal of protecting natural processes. It may not achieve its goal for several reasons:

1. The permitted uses are not necessarily compatible with the natural processes to be protected. Agriculture and recreation uses can have adverse impacts on natural resources if developed in the wrong way.

2. The segregation of uses may keep some potentially damaging uses away from critical resources, but it also unnecessarily restricts the use of the land, reducing the supply of residential, commercial, and industrial land. These uses are often compatible if developed in the right way.

3. The segregation of uses assumes that the buildable and the unbuildable land are separate systems, and that the adjacent residential or industrial zones will not affect the area being protected. This is not necessarily so. The effects of development on erosion, runoff, and groundwater recharge can cause damage to all areas in the watershed.

In attempting to refine land controls so that they more accurately implement the goal of preserving natural processes, communities have shifted the emphasis from the particular uses of the land to the way the land functions or performs. As this manual details, they have identified the functions of the land which provide important public benefits, and have designed their regulations to protect these functions. In addition to being concerned about the specific use of the land--whether it is agricultural or residential--they are concerned with the land's continued ability to filter runoff or recharge important groundwater reserves, or maintain soil stability. These are the natural processes which they want to maintain whatever use the land provides for man.

The development of performance orientation controls for land use has been principally on a second level of zoning. The communities have maintained the traditional Euclidian zoning with a designation of permitted and prohibited uses, but then have added another level of use through special use provisions and special use permit systems. Through these provisions, a landowner can use his land for other uses than those specified in the ordinance if he meets specific environmental performance criteria. These criteria generally delineate the key functions that the community wishes to perserve such as the water retention capabilities of wetlands or the water absorption ability of aquifer recharge areas. The landowner is allowed to develop the land anyway he wishes if he can show that it will not adversely affect these natural processes. Each application is then evaluated individually on how well it meets the criteria.

This system of providing for special uses that satisfy performance criteria moves land controls closer to achieving its goal of preserving and maintaining natural processes, while allowing the land to change for man's use. Specifically, it overcomes the second weakness of traditional Euclidian zoning by not unduly restricting the use of the land and consequently unnecessarily reducing the supply of residential, commercial, and industrial land. It does not, however, answer the other two problems. The list of permitted uses do not have to meet the same performance criteria as the special uses, and it still does not regulate the effects of adjacent uses or the interaction among uses on critical natural functions.

In order to remove these additional problems of implementing the goal of protecting natural process, it is necessary to move to direct environmental performance standard regulation. To develop this system of regulation, a community identifies the natural processes that are closely associated with public health, safety and welfare; that provide the community important benefits that are ignored through the private market mechanism. Specifically these are processes such as runoff, erosion, and groundwater infiltration which are closely linked to maintaining public water supplies, preventing hazards from floods and droughts, preserving water quality in lakes and rivers and maintaining the natural resource of the soils themselves. The community then establishes a specific (preferably numerical) level at which the natural process should operate, and any development of the land must be done in such a way that the natural process continues to function at this level. In contrast to a specification approach, this kind of regulation does not require designated construction techniques or site planning, but allows the developer to choose his own system of guaranteeing that the natural processes continue to operate.

If these environmental performance standards are simply applied to environmentally sensitive areas, such as wetlands or stream corridors, then the regulation does not stipulate permitted or prohibited uses. A landowner (leaving aside for the moment other considerations) can use the land as he wants as long as it continues to retain a minimum amount of water during rains, release the same quality and quantity of water into adjacent water bodies, and continue to recharge the groundwater at approximately the same rate. With this direct environmental performance regulation, all uses must meet the same standards for preserving or maintaining natural processes and the distinction between permitted uses and special uses is removed.

More importantly, however, these environmental performance standard regulations do not need to be tied to specific zones or districts. Since these processes of runoff, erosion, and infiltration are common to all land (although they vary from site to site), the regulations can apply to all development within the jurisdiction. By doing this, these environmental land controls are separated out from the questions of districting or zoning, and are administered as parallel or supplementary regulations to the basic zoning controls. By separating out controls for these natural processes, the final problem of the Euclidian approach is solved. The controls no longer depend on identifying different districts with different controls, but operate equally in all districts.

Using environmental performance standards as general regulations for all development provides the most important type of controls for resource management or protection. As detailed in this manual, all of the environmentally sensitive areas studied can substantially benefit from controlling development effects development effects that are essentially external to their boundaries. Part of the intent of providing special districts for these areas is to reduce the problems of increased runoff, reduce the damage of siltation from erosion, and maintain water quality. These zones are important for those purposes, but they can be substantially augmented by minimizing these problems at their origins--at the actual site of development.

Besides their particular importance to the protection of environmentally sensitive areas, direct environmental performance standard regulations offer other advantages. Many of these are similar to those for performance standards in building codes and industrial zoning:

1. Environmental performance standards tend to encourage innovation to improve the compatibility of development with the natural functions of a particular site and an entire watershed. This flexibility is particularly important in the area of resource protection since there are a host of construction and site design techniques which can be combined to make development more sensitive to land functions. By allowing the landowner to find the best techniques for his particular site will give the community better protection of its resources and the landowner a greater chance to maximize his own benefits.

2. Environmental performance standards eliminate the need for the drafters of the code to know about and test all available methods of development. The burden of proof is shifted to the proponent of the particular use, and he can provide the necessary technical evaluation from licensed engineers or hydrologists to determine if the development will maintain the natural functions at the levels specified by the community.

3. Environmental performance standards more accurately separate uses that are compatible with the natural systems from those that are not. If a particular site is unbuildable it will be determined by the particular character of that site, and does not need to be predetermined on a zoning map.

Environmental performance standard regulations however, are not completely parallel to performance standards for building codes or industrial zoning. In these other cases, society is attempting to create a performance level from man's use of the land; in environmental performance standards, it is attempting to preserve or maintain a performance of the land that is already there. As a consequence, environmental performance standards have some additional advantages that are not associated with general performance standard regulations.

The major advantage that these direct environmental performance standard controls have is to disentangle one thread of land controls--preserving natural functions or processes, to handle them separately from the questions of the segregation of uses or traditional zoning. In the past one objective of performance standard regulation has been to increase the potential for multiple use of land. Specifically this is the objective of industrial performance standards. Regulating the location of industry by the way it performs allows for greater flexibility in locating specific industries. This may or may not be the case with environmental performance standards. The protection of the natural processes or functions of the land becomes independent of the particular land use; all land must maintain these functions. The question of where industry locates or what areas are designated for residences is determined by other criteria, such as the concentration or proximity of one use to another, the costs of providing public services, the effects of particular uses on traffic generation, and so on. Environmental performance standards do not replace standard zoning procedures; instead, they parallel or supplement these by providing regulations maintaining environmental systems. Their primary advantage is that they remove one traditional element of the segregation of uses so that those decisions can be made in terms of other policy considerations independent of the uses affect on natural processes.

The same is true in terms of zoning for environmentally sensitive areas. Many of these areas include land functions which at the present time cannot be quantified so that it is impossible to develop reliable performance standards for these functions. Consequently, the performance standard regulations offer an important supplement to these other land controls and do not represent an alternative to them.

Finally, the direct environmental performance standard regulation greatly improves the equity of environmental controls. Often our attempts to provide a stable supply of clean water have focused on requiring major pollutors to clean up without requiring all land users to do the same. By establishing environmental performance standards for the major processes that affect a community, one sets up the same standard for all land users, and each must share in the process of protecting natural resources in proportion to the problems his particular uses creates. Likewise, in the past, the solution to the problem of increased runoff, erosion, and water pollution focused on the critical points in the hydrological cycle. Providing buffers around streams or requiring limited use of land adjacent to wetlands was necessary because they were seen as the prime chance to reduce these problems before they did serious damage to larger bodies of water. These controls make sense, but, as much as possible, the burden of controlling these problems should rest with the landowner who initiates the problems and not be shifted to the landowner who happens to own the wetlands. Performance standards are a major step in providing this equity in land controls since they move the process of control back to the landowner who initiates the changes.

II. DEVELOPING DIRECT ENVIRONMENTAL PERFORMANCE STANDARD REGULATION

The critical factor in determining the feasibility of performance standard regulation for natural processes is the technological feasibility of setting precise numerical measurements on the process. There has been substantial, ongoing, research activity in the definition of behavioral relationships of these systems and the accumulation of data to support these basic relationships. There has been, however, comparatively little effort directed towards extending this research into the area of land use controls. The basic technical research is being conducted by specialists: soil scientists, engineering geologists, hydrologists, marine biologists, and forest ecologist. Understandably their concerns tend to be limited to the characteristics of the resource studied and not into the area of land controls. Few planners, on the other hand, have attempted to establish the necessary disciplinary crosswalk.

In order to evaluate what is necessary to establish performance standard regulation, we have chosen two natural processes which are both important and which also seem the closest to being able to be regulated through the performance standard approach. These two processes are runoff and erosion. For runoff there already have been a few attempts to develop performance regulations and a discussion of these specific ordinances give a clearer understanding of possible methods of actually adapting performance standard measures to regulatory mechanism. For the second case, erosion, there are no performance standard regulations at the present moment, but the work of the Soil Conservation Service in developing the Universal Soil Loss Equation and identifying "allowable" soil losses for specific soils,provides the necessary technical work to make regulation of these natural processes within immediate possibility.

1. Controlling Runoff

Runoff is a natural process associated with surface water hydrology. On undeveloped land, soil and vegetation act as control agents, holding some water, releasing some. With precipitation, the holding function is first maximized then, when the holding capacity is exceeded, release follows. For melting snow, the runoff function is higher until the ground has thawed. Under natural conditions, runoff generally holds few threats to human population or to related sensitive areas. In the natural system runoff is accomodated by additional processes associated with floodplains and wetlands.

With the advent of development, the runoff process is changed. As the natural landscape is replaced by development's impervious surface, both the rate and volume of runoff increases dramatically. In the past, this increased runoff has been handled by requiring developers to build storm drainage systems or relying on public investment in exotic storm systems, channelized watercourses, dams, and reservoirs. These solutions essentially focus on the symptom rather than the cause; the increased flow of water is accepted as a given and the controls simply try to handle this new flow instead of controlling the amount of water itself. Performance standards for runoff control the actual amount of water leaving a particular site at a particular moment.

a. The measurabl features of runoff--The two measurable features of runoff are volume and rate. The volume of runoff is a function of previous moisture conditions, the hydrologic character of the soil, and the presence or absence of conservation practices. Previous moisture conditions are a statement of the amount of moisture the soil contains prior to a given storm. The hydrological character of the soil is determined by its surface and subsurface characteristics that effect moisture entering and passing through a soil and its water storage capacity. Thousands of soils have been classified by the Soil Conservation Service into four hydrological soil groups ranging from low runoff potential to high runoff potential. Last, the volume of runoff is related to conservation practices on the land, particularly those designed for sheet erosion. For example, various grasses maintain the open structure of the soil surface which increases the soil's ability to absorb precipitation.

In addition to the features that affect volume, the rate of runoff is a function of the intensity of the rainfall, natural vegetation and topography. The more intense the rainfall, the higher the rate of runoff. The more dense the vegetation, the more it will hold water and thereby reduce peak discharge rates, and finally, the steeper the slope of the land, the more rapid the runoff.

As the factors that affect volume and rate of runoff suggest, the process varies considerably from site to site. For regulatory purposes, the method of estimating runoff must meet three basic criteria:

1. They must be geographically adaptable, capable of working with large and small scale development.

2. They must estimate differences for varying meterological conditions.

3. They must be able to predict runoff for varying intensities and styles of development by kinds of soils.

By meeting these criteria the community could determine the amount of runoff associated with a particular parcel before development, and could estimate its volume and rate under developed conditions. They could then set a specific standard which the development had to meet.

Fortunately, there has been considerable work in devising measurement techniques which satisfy these requirement. In nearly three decades of research, runoff models have achieved a high degree of accuracy, and they have been applied to increasingly small units with no perceptible loss in accuracy. Although this work was initially addressing problems of runoff in agricultural areas, it has been adapted to urbanized conditions, and gives the best help in designing regulations for the process of runoff.

There are approximately seven different models developed for estimating the rate of runoff. (See listing at the end of this appendix for the sources and methods of operation.) Of these, the most common is called the "Rational Method." The basic equation is $Q = (Cia)$ where "C" is the runoff coefficient, "i" is the rainfall intensity for the area and "a" is the watershed area in acres. Regional values have been developed for both "C" and "A" over a period of several decades. "C," the runoff coefficient, merely reflects the physical characteristics of the site such as soil type, slope, and conservation measures. "I" reflects the probability of various rainfalls in terms of intensity and duration, while "A" is the size of the site under consideration. Newer methods, such as that developed by Beasely, are directed towards estimating for smaller and smaller geographical units. In Beasley's model, nine factors are used to determine the runoff rate in contrast to the three used in the Rational Method. The additional factors are nothing more than an elaboration of the basic three identified above. Like the rational model, Beasely uses essentially the same data but at a finer resolution.

Knowing the watershed can safely handle a particular rate of runoff, the community regulates development in terms of values of the runoff coefficient "C." Presumably most areas would want to maintain the runoff coefficient close to natural conditions since this would reflect the natural capacity of the watershed's wetlands and floodways. However, it is possible to also set these standards at higher or lower levels given particular characteristics of the watershed. The potential of a development for meeting these standards could be calculated by substituting the proposed factors into the calculation of the "c" values.

The estimation of volume of runoff works much the same way. For this feature of runoff, the Soil Conservation Services has developed a model based on storm flow records. The equation is:

$$Q = \frac{(I - 0.2S)^2}{I + 0.8S}$$ where:

Q is direct surface runoff in inches

I is the storm rainfall in inches

S is the difference between the rainfall and runoff

The values for "I" have been determined from empirical data on a regional basis. Records of storm rainfall have been maintained for over a hundred years for most of the country. The value for "S" reflects the site specific physical considerations which determine the difference between rainfall and the amount of runoff. If the surface is largely impervious the "S" value is high. If the surface is porous the "S" value is low. The calculation of these "S" values provides the mechanism of predicting the effects of development on the volume or runoff produced. (For detailed discussions of calculating these values see the bibliographical references.)

b. Translating runoff estimates into regulations--A few communities have developed regulations which incorporate these measurements of runoff into active regulatory programs, and they provide excellent examples of how these regulatory devices are designed.

One of the first agencies to develop performance standards for runoff was the Metropolitan Sanitary District of Greater Chicago. With their broad powers in the issuance of sewer permits for new construction, the Board moved to include consideration of runoff into their issuance of sewer permits. As adopted by the Board, the Sewer Permit Ordinance stated that:

> Effective January 1, 1972, no permits shall be issued for sewer construction in unsewered or separate sewered areas when construction of the facilities to be served by the proposed sewer would result in runoff in excess of that from its natural or undeveloped state. . . .

The objectives of these regulations are to maintain the integrity of the natural drainage patterns of the area in order to pervent flooding and serious alteration in stream channels. As they stated in their controls: "the channel configuration cut by nature are generally unable to handle the runoff from high intensity rainfalls and results in flood plain storage or spreading of runoff over the land." In order not to increase the runoff from such areas after the development, the Sanitary District requires that the release rate be limited to the carrying capacity of the natural channels.

The regulation itself mandated minimum performance standards in terms of both the rate of runoff and the volume which the local governments had to implement. For the rate of runoff the ordinance states:

> The release rate of storm water from all developments requiring detention shall not exceed the storm water runoff rate from the area in its natural state.

For considerations of volume, the District requires detention storage which operate in conjunction with the standards for the rate of runoff:

> The live detention storage to be provided will be calculated on the basis of the 100 year frequency rainfall as published by the U.S. Weather Bureau for this area. The detention volume required will be that necessary to handle the runoff of a 100 year rainfall, for any and all durations, from the fully developed drainage area tributary to the reservoir, less that volume discharged during the same duration at the approved release rate.

Even under the worst meteorological conditions, the land area is to function as it would under natural, predevelopment conditions.

The result of this metropolitan wide regulation was the adoption by local agencies of runoff controls based upon these minimum guidelines. While the district set the minimums, the local communities are free to make upward adjustments, to increase the required level of performance. The developers' response are functions of the conditions of a particular site. If the site has few problems with runoff from development, the requirements are light. If the site is particularly susceptible to increases in runoff, the compliance would require more adjustment by the developer.

In December, 1972, Naperville, Illinois, adopted an ordinance conforming with the requirements of the Metropolitan Sanitation District. As stated in the ordinance, its central purpose was "to eliminate the storage or transportation of excess storm water in or through habitable structures." The ordinance covers all commercial and industrial developments, and all residential development containing an area greater than two and one-half acres.

The performance standard for runoff is directly tied to the capacity of the watershed drainage system:

> The controlled release rate of storm water runoff from all developments described in Paragraph A, shall not exceed the existing "safe" storm drainage capaicty of the natural downstream outlet channel or storm sewer system. The release rate shall be an average value computed as a direct ratio of the tributary watershed area. This value shall not exceed an average runoff rate of 0.15 inches per hour which is compatible with the "safe" capacity of the West Branch of the Du Page River and the Des Plaines River. The rate at which storm water runoff is delivered to a designated storm water storage area shall be unrestricted.

Performance standards were also established for the control of the volume of runoff:

> Required volume for storm water detention shall be calculated on the basis of the runoff from a 100 year frequency rainfall of any duration as published by a recognized agency. This volume of storage shall be provided for the fully developed watershed that is tributary to the area designated for detention purposes. The storm water release rate shall be considered when calculating the storm water storage capacity and the control structure designed to maintain a relatively uniform flow rate regardless of the depth of storm water in the storage area.

Although the Naperville ordinance maintains specification standards for the design and maintenance of detention facilities, the principle focus is on performance standards. Presumably if a developer could show how his designs would not exceed the required release rate for a hundred year frequency rainfall, he would not have to build the specified detention facilities.

The city of Joliet, Illinois's ordinance illustrates the basic policy considerations inherent in setting these standards. Like Naperville, the rate of runoff cannot exceed historic values or the capacity of the drainage system, and storage facilities must be provided for a volume of runoff equivalent to the 100 year rainfall. But the development which come under the provisions of the ordinance are different. The regulations in Joilet apply to development of 10 acres or more for residential and 5 acres or more for all other development, and these development are regulated only when the impervious cover exceeds 60 per cent of the site. Local conditions have allowed Joliet to be much more permissive for runoff controls; consequently they have set a different range of acceptable performance than that of Naperville.

A slightly different approach has been taken by DeKalb County, Georgia. This county passed an ordinance relating to soils, topography, vegetation, drainage, and flood plains. Performance standards are utilized in the section of the ordinance dealing with storm water retention and drainage. The definition of who is covered under the ordinance is itself performance oriented:

> . . . A combination of storage and controlled release of storm water runoff shall be required for all development and construction which will increase the peak rate of runoff from the site by more than (1) cubic foot per second for a ten (10) year frequency storm.

The ordinance then goes on to set the performance standard for the rate of runoff:

> The peak relaese rate of storm water from all developments where retention is required shall:
>
> (1) not exceed the peak storm water runoff from the area in its natural undeveloped state for all intensities up to and including the 100 year frequency and all durations of rainfall; or
>
> (2) not be greater than that calculated for a storm of two (2) year frequency with a runoff coefficient of 0.20, 0.25, and 0.35 for land with an average slope of up to 2 per cent, 2-7 per cent and over 7 per cent respectively.

Through this mechanism they have set a minimum requirement for all development, and added more stringent requirements for developments on slopes. Finally, the ordinance sets the performance standard for the control of the volume of runoff:

> The live retention storage to be provided shall be calculated on the basis of the hundred (100) year frequency rainfall as published by the National Weather Service for the affected area. The retention volume required shall be that necessary to handle the runoff of a hundred (100) year rainfall for any and all durations, from the proposed development less that

volume discharged during the same duration at the approved release rate as specified above.

The DeKalb County controls are entirely performance oriented; they do not specify nature or character of retention facilities, but leave this up to the developer. It is interesting to note that the County still plans to construct storm retention facilities itself, but now they will operate as a service to landowners. If the developer does not wish to build his own facilities he can use those constructed by the community, but he will be assessed in terms of the runoff he contributes to the drainage system. Under this system a developer can balance his costs of reducing runoff on site with those of buying a service from the community.

This system of economic tradeoffs has been actually written into the runoff ordinances of two Colorado communities. Arvada, Colorado requires that on-site controls for runoff be provided for all runoff in excess of historic levels. If the developer does not choose to control this runoff, he is subject to an assessment which reflects the cost of providing controls for his development. The assessment is based upon the runoff contribution of the site and the fees can range from $54 to $4,000 per acre depending upon runoff sensitivity of the particular area. If the developer provides the necessary controls, no assessment is made. If the cost of control exceeds that of the assessment, the city reimburses the developer for the difference. Boulder, Colorado has used a similar system by designing drainage charges that are determined by the amount of runoff from a lot. The basic charge is established in a "standard lot" which identifies both lot size and appropriate runoff coefficient. Fees are assessed in comparison with this standard lot so that if one lot has twice the runoff of another, the charge would be twice as much. The greater the runoff, the greater the assessment, so it is to the advantage of the development to minimize runoff.

c. Conclusions--As indicated by the above discussion, performance standard regulation for runoff is feasible. The necessary measurement techniques are available, and the communities that have pioneered this work feel that they have significantly improved their methods of controlling these problems. In addition, the controls have proved to be within the response range of developers. In some cases they have found that they have been able to reduce their cost of construction by using different techniques than previously specified by the community. With the technological improvements in porous pavement, rooftop detention, ponding, and artifical recharge basins, one can expect that these standards will more easily be met in the future.

2. Controlling Erosion

One of the most significant problems associated with development is erosion. It has been found that man's activities significantly increase the process of erosion; land during development can produce soil loss as great as 100 times more than under natural conditions. This increase in erosion, increases problems of siltation in wetlands and streams which in turn destroys breeding grounds for game fish and other wildlife; or it causes increased turbidity in lakes and rivers which in turn produces undesirable algae blooms causing europhication and oxygen depletion in these water resources. All of these associated problems can be allieviated by controlling the erosion process at its origins, the site of development.

Many local agencies have developed regulatory programs dealing with erosion controls. Most of these ordinances regulate the process of land development. They either set out specifications for development, such as requiring siltation ponds or other devises to control erosion problems, or they require an erosion control plan which is evaluated by a series of erosion control principles. These evaluative principles are statements concerning good conservation practices. They state, for example, that the area stripped of vegetation be kept to a minimum at all times or that denuded areas be covered with vegetation as quickly as possible. These principles offer an important tool to control some of the worst abuses of land development, but they do not provide comprehensive performance standards that have to be met during construction and after construction.

a. The measurable features of erosion--During the past decade, there has been a great deal of research on the process of erosion. While the research was initially directed towards problems of agricultural uses, it has since included erosion associated with urbanization. The research has attempted to establish the relationships among the various factors contributing to erosion output: rainfall intensity, average slope, length of slope, soil type, and conservation practices.

The most important model for the purpose of environmental performance standards is the Universal Soil Loss Equation: A = (RLSKCP). The soil loss per unit area per year, "A," is a product of:

R -- the factor for rainfall,

L -- the factor for length of slope,

S -- the factor for degree of slope,

K -- the factor for the erodability of the soil,

C -- the factor for cropping and management techniques, and

P -- the factor conservation practices.

By calculating each factor and multiplying, the equation estimates the sheet erosion which will occur under different uses of the land.

For the majority of communities, this formula is usable for regulation since the necessary data has been collected. It is useful here to detail information sources and develop an example of how this formula could be adapted for regulatory purposes:

A = (RLSKCP)

--"A": The product of the equation.

The product is usually expressed in tons per acre per average yearly rainfall--although it can easily be converted to metric units. This number represents the estimated amount of sheet erosion which can be expected under the conditions specified by the other factors. Sheet erosion is general soil loss over an entire area, and this soil loss can be augmented by rill erosion--gully production--where greater erosion occurs because water begins to be channelized into drainage patterns. In order to account for rill erosion, the factors of the equation must be adjusted. (See Erosion and Sediment Control Handbook for Allegheny County, Penn., County of Allegheny Planning Department, (1971), p. 109.)

--"R": The rainfall factor.

This value is a representation of the power of rainfall to erode the soil. These values are related to the specific climate and geographic character of the area, and have been calculated on a regional basis for all states east of the Rocky Mountains. The regional rainfall factors represents a given in the regulatory system and would be the same for all development. The R values are published in an Iso-Erodent Map in the Agriculture Handbood No. 282.

--"L" and "S": The slope factors.

"L" is the length of slope and "S" is the degree of slope. Since erosion is a function of both length and degree of slope, these two factors are combined by using the following equation: $LS = L(0.0076 + 0.00076s^2)$ where "L" is the length of slope in feet and "s" is the per cent slope. Alternatively, this equation has been graphed and may be found in Wischmeier's "The Erosion Evaluation: A Tool for Conservation Planning" (Procbedings of the Soil Conservation Society of America, Twenty-Sixth Annual Meeting, 1971, p. 75.) These factors are site specific and would be obtained from topographic maps or on-site surveys for the particular site of development. They are also factors which may change if the particular development plans include extensive grading or filling so that they may be one of the factors that would determine the before and after characteristics of development.

--"K": The factor for erodability of the soil.

Soils erode at different rates and "K" values have been determined for major soil classes. For soils without known "K" values, Wischmeier has developed a nomograph using particle size distribution, organic matter content, and structure and profile permeability. This nomograph may be used to determine "K" values for both topsoils and subsoils. Since topsoil and subsoil have varying erosion characteristics, it is useful to determine "K" values for both if the subsoil is likely to be exposed. The published "K" values are available from the Soil Conservation Districts and the nomograph is found in Wischemier, Johnson, and Cross's "A Soil Erodability Nomograph for Farmland and Construction Sites" (Journal of Soil and Water Conservation, XXVI, 5, pp. 189-193). Like slope considerations, this factor is site specific, but like rainfall it is essentially a given--although a development could minimize this factor by not exposing subsoils that are particularly erodable.

--"C": The cropping and management factor.

Since management practices influence erosion from any single site, this factor adjust the erosion potential for these management practices. For agriculture it would include vegetative cover, soil tillage, and crop sequences; for other development, it would adjust the equation for erosion control devices such as siltation ponds or artificial cover. Low "C" values are associated with very effective erosion control methods while higher "C" values are associated with less effective or the absence of controls. The highest "C" values of 1 would be given to site with fallow ground; lower "C" value of 0.01 could be given to a site which was completely covered with permanent vegetation. "C" values for the many devices used in agriculture are found in the Agriculture Handbook 282, and additional "C" values may be found in Wischmeier's "The Erosion Equation: A Tool for Conservation Planning," and G.H. Brant's An Economic Analysis of Erosion and Sediment Control Methods for Watershed Undergoing Urbanization (Midland, Michigan, 1972).

--"P": Conservation factor.

This factor is similar to the "C" factor but deals with such items as strip cropping, terracing, and contouring. For urban development it would reflect landscaping and contouring practices which would reduce erosion. The values for this factor are also available from Agriculture Handbook 282. Often this factor is given the highest value of 1 when land is undergoing urbanization. This assumes that no specialized techniques are used in the clearing or grading process. In terms of a regulatory tool it is this factor along with the "C" factor which would determine if the particular erosion control plans would satisfy the performance required by the community.

In solving for "A," the value for each factor is determined and then multiplied through (RLSKCP) in order to arrive at an estimated tons per acre per unit of time. By way of example, the following problem is extracted from Wischmeier's "The Erosion Equation: A Tool for Conservation Planning":

ASSUMPTIONS

1. Fairfax County, Va. as the locale of an unvegetated construction site.
2. The disturbed area is 20 acres in size.

3. The average slope is 10 per cent.

4. The slope length is 200 feet.

5. The Soil Survey Map shows the site on an eroded rolling phase of enon silt loam.

6. The subsoil material may be exposed.

PROBLEM: To compute the estimated soil loss from the unprotected surface of the site for a 12 month period.

Step 1: R factor value is available from Iso-Erodent Map in Agriculture Handbook #282. For Fairfax County R has a value of 200.

Step 2: Determine the LS value for a slope length of 200 feet and an average slope of 10%. Using the graphic "Slope-Effect" chart, we get an LS value of 1.93 for this construction area.

Step 3: The RLS value is then 200 x 1.93 = 386 RLS Units

Step 4: Determine K factor value: From soil survey maps or on site inspection, the main soil horizons are defined. K values for each horizon are available in local SCS data or through the nomograph method identified previously. In this case, K values had to be determined for 5 horizons:

for 5 horizons:

Horizon	K value
Ap-	.45
B1	.42
B2	.33
B3	.22
C	.43

(Note: A Horizon is topsoil, B is sub, C is the underlying geological material. We are dealing with three horizons and a total of four soil types.)

Step 5: Determine C value. Since we assume that the site will be stripped of cover, this value is 1.

Step 6: Determine P value. Since we assume that no special precautions will be taken in grading the site, this value also assumes the level 1.

Step 7: Multiply R(200) x LS(1.93) x K for Ap(.45) x C(1) x P(1) = 174 tons per acre per average rainfall year; 174 tons per acre x 20 acres = 3480 tons for site for average yearly rainfall. It should be remembered that this estimate refers only to the condition of the upper most soil horizon (Ap). It assumes that only this horizon will be exposed. If any one of the remaining horizons are exposed, different K values would be substituted.

The development of this formula establishes a powerful planning tool for regulatory practice. This equation enables planners to identify in very precise fashion the expected sheet erosion in tons per acre for an average rainfall year in 36 of the 50 states. The formula both estimates existing erosion and estimated erosion under a variety of developmental patterns. Because the equation accommodates a variety of land areas, developmental conditions, and erosion controls methods, it offers excellent potential for regulation.

b. Developing regulation for erosion--As opposed to runoff controls, the use of the research models for erosion have not yet been incorporated into actual controls. The one community that has established a performance standard regulation for erosion is Leon County, Florida. This community's ordinances sets up performance standards for the control erosion and sedimentation as well as runoff. The ordinance, with a few minor exceptions, requires that:

> . . . Any person, who intends to make changes in the contour of any land proposed to be subdivided, developed or changed in use by grading, excavating, removal, alteration, or destruction of the natural topsoil, hereinafter referred to as clearing and development operations, shall, prior to engaging in such operations, submit a site plan showing:
>
> (a) The nature and extent of the proposed clearing, grading, and development operations; and
>
> (b) The plans to be implemented by such person for controlling on-site generated sedimentation, erosion, and runoff, said plans to be designed to control runoff to prevent damage to downstream property owners and to remove sediment prior to discharge of peak storm runoff from storms having a recurrence frequency of 25 years. Rainfall intensity curves as developed by the Florida Department of Transportation shall be the basis of design. Designs and calculations for such facilities shall be submitted to the Environmental Administrator upon request.

Although not explicit in the ordinance, the community operates on the standard that there will be no greater sediment load in the runoff than would occur under natural conditions. This standard applies to both construction and finished development. To comply with this requirement, the developer has the choice of either having his plans certified by a licensed engineer or to submit them to the Environmental Administrator of Leon County and have them evaluated by that agency.

Although Leon County does not use the Universal Soil Loss Equation, the equation provided could be easily adapted to this style of control. The equation both estimates the anticipated sheet erosion under predevelopment conditions and that for various forms of development. It likewise can be used for a specific time perspective. When specified, the equation produces estimates at a monthly, quarterly, or yearly basis. If the local agency is only concerned with development plus one month, it can be done.

If a longer time frame is important, the regulations could be set on the basis of annual sediment soil.

With this information, the community defines a level of performance for the control of erosion. Such a performance standard reflects the desired levels of erosion control that are necessary for the protection of the community's resources. The standard could be set at 95 per cent, 90 per cent, or 85 per cent effectiveness depending upon local conditions. Then all landowners would be responsible limiting erosion from their land to that level. The particular response of the landowner could be evaluated by the equation--specifically in terms of the "C" and "P" values associated with erosion management methods.

If the community wanted to tie the controls more specifically to the nature of the site to be developed, they would use the erosion control formula to establish predevelopment production of sediment load, and then set the standard in terms of that particular lot. Then the developer would be responsible to handle the extra erosion created by his particular use of land. In the previous illustration, for example, the formula estimated an expected yearly average erosion of some 3480 tons for 20 acres of land undergoing development. If the formula is used to estimate erosion under its existing conditions, it would show a different, lower estimate--say 1080 tons per year average. The increment associated with development would then be 3480 - 1080 = 2400 tons. For that specific development, the local agency would require controls that would accommodate that 2,400 tons or some percentage of it.

c. Conclusions--Since the Universal Soil Loss Equation has not been used in an actual local regulatory program, there are still unanswered questions. Without actual experience with the process it is difficult to determine if the data is accurate enough to evaluate the precise nature of development decisions, or if it would require specialized training on the part of the administrators of the regulations, or if the necessary monitoring and follow-up procedures would be costly for the community. The advantage of establishing this kind of precise standard for erosion, however, is clear, and at this point seems feasible for local agencies.

BIBLIOGRAPHY

The works listed below represent basic explanations of the Universal Soil Loss Equation, an equation used for predicting the amount of soil that is likely to be eroded from a land area, under varying conditions. Entry number one describes the equation, its factors and gives working examples of the use of the equation in predicting soil loss on a construction site and cropland. The second entry describes an equation used to arrive at a value for K, soil erodibility, for soil types that have no assigned K value. The third entry is a Handbook that also gives a basic explanation of use of the equation and gives values for P, erosion control effectiveness of various conservation practices.

1. Wischmeier, W.H. "The Erosion Equation: A Tool For Conservation Planning," *The Shape of Things to Come*. Soil Conservation Society of America, 7515 Northeast Ankeny Road, Ankeny, Iowa 50021

2. Wischmeier, W.H. and C.B. Johnson, and B.V. Cross. "A Soil Erodibility Nomograph for Farmland and Construction Sites," *The Journal of Soil and Water Conservation*. Nov.- Oct. 1971, Vol. 26 No. 5. pp. 189-192.

3. Wischmeier, W.H. and D.D. Smith. *Predicting Rainfall: Erosion Losses from Cropland East of the Rocky Mountains*. Agriculture Handbook 282. U.S. Department of Agriculture, Washington D.C. 1965.

The works listed below are erosion and sediment control handbooks for state and local areas. All three outline basic principles and guidelines for use in minimizing erosion and sedimentation and suggest management techniques that may be used. In entry one, Appendix B. explains the USLE and gives necessary data for its use in the county. It also includes several sample problems applicable to the county. The Fairfax County Handbook contains a similar section (section X), with data for that area. The New Jersey handbook gives soil loss equation data for the state and explains the equations used in Appendix A.

1. Allegheny County Soil and Water Conservation Districe and Allegheny County Planning Commission. *Erosion and Sediment Control Handbook for Allegheny County, Pennsylvania*. Allegheny County Pennsylvania. 1971.

2. Fairfax County, Virginia, *Erosion: Silatation Control Handbook*. Department of County Development, Fairfax County, Virginia 22030. 1971

3. New Jersey State Soil Conservation Committee. *Standards for Soil Erosion and Sediment Control in New Jersey*. Trenton, New Jersey. 1972.

The following document analyzes the economic impact of the effects of urbanization on a watershed. It has attempted to estimate cost of damage from sedimentation and erosion and to weigh those costs against the cost of control practices. It has also analyzed the effectiveness of erosion control, as compared to its cost. Section 5 describes the use of the USLE in estimating gross erosion from two small watersheds in the study areas.

1. Brant, G.H. An Economic Analysis of Erosion and Sediment Control Methods for Watersheds Undergoing Urbanization (C-1677). Midland, Michigan. 1972.

The following references are general discussions of runoff. Included are definitions of runoff, explanations of the runoff process and the factors that affect rate and volume of runoff. The first entry describes the equation used to estimate rate of runoff and gives some regional values used in the equation. The second entry describes the equation to estimate volume of runoff.

1. Beasley, R.P. Erosion and Sediment Pollution Control. Ames, Iowa. 1972. Chapter 5.
2. Schwab, Glenn O., et al. Soil and Water Conservation Engineering. New York, N.Y. 1955.

The following reference explains estimation of direct runoff from storm rainfall and melting snow, respectively. Included are sample tables used in the equation.

1. Soil Conservation Service. SCS National Engineering Handbook. Section Four, "Hydrology." Washington, D.C. 1971. (Chapters 10 and 11.)

The following reference outlines runoff control measures for urban areas. On page 39 begins a listing of measures to control increases in runoff and decreases in infiltration due to urban development. A number of techniques for delay of runoff from roofs, infiltration of precipitation at source, and infiltration of runoff after concentration are developed.

1. Tourbier, Joachim, and Richard Westmacott. Water Resources Protection Measures in Land Development: A Handbook. Newark, New Jersey. 1974.

APPENDIX A-1

ORDINANCE NO. 72 - 74

AN ORDINANCE AMENDING CHAPTER 12, "PLUMBING, SEWERS AND WATER" BY THE ADDITION OF ARTICLE IX,"STORM RUNOFF CONTROL.

BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF NAPERVILLE, DU PAGE AND WILL COUNTIES, ILLINOIS, in the exercise of its home rule powers, as follows:

SECTION 1: That Chapter 12, "Plumbing, Sewers and Water", of the Municipal Code of Naperville of 1960 as amended be and the same is hereby amended by the addition of Article IX "Storm Water Runoff Control" to read as follows:

"Article IX Storm Runoff Control"

12.901 - Definitions - The following definitions shall be applicable to this article:

1. Storm Water Runoff - Water that results from precipitation which is not absorbed by the soil or plant material.

2. Natural Drainage - Channels formed by the existing surface topography of the earth prior to changes made by unnatural causes.

3. Excess Storm Water - That portion of storm water runoff which exceed the transportation capacity of storm sewers or natural drainage channels serving a specific watershed.

4. By-pass Channel - A channel formed in the topography of the earth's surface to carry storm water runoff through a specific area.

5. Storm Water Runoff Release Rate - The rate at which storm water runoff is released from dominant to servient land.

6. Storm Water Storage Area - Areas designated to store excess storm water.

7. Tributary Watershed - All of the area that contributes storm water runoff to a given point.

8. Recognized Agency - An agency or governmental unit that has statistically and consistently examined local and climatic and geologic conditions and maintained records as they apply to storm water runoff, e.g., Metropolitan Sanitary District of Greater Chicago, U.S. Weather Bureau, University of Illinois Engineering Experiment Station, Illinois State Water Survey, etc.

9. Dry Bottom Storm Water Storage Area - a facility that is designed to be normally dry and contains water only when excess storm water runoff occurs.

10. Wet Bottom Storm Water Storage Area - A facility that is designed to be maintained as free water surface or pond.

11. Control Structure - A structure designed to control the volume of storm water runoff that passes through it during a specific length of time.

12. Positive Gravity Outlet - A term used to describe the drainage of an area by means of natural gravity so that it lowers the free water surface to a point below the existing grade or invert of storm drains within the area.

13. Ground Water Recharge - Replenishment of existing natural underground water supplies.

14. "Safe Storm Drainage Capacity" - A term used to describe the quantity of storm water runoff that can be transported by a channel or conduit without having the water surface rise above the level of the earth's surface over the conduit, or adjacent to the waterway.

12.902 - Regulations - It is not the intent of this article to take areas out of use for the sole purpose of storing excess storm water. Nor is it the purpose of this article to restrict land use or increase development costs. The basic purpose of this article is to eliminate the storage or transportation of excess storm water in or through habitable structures. The use of "natural" paths of storm water runoff to form the "by-pass" channel and the restriction of this channel to form storage areas is encouraged. Since political and ownership boundaries often make the use of "natural" drainage patterns difficult, the earthmoving that is accomplished to create the maximum land usage should also be planned to provide a "by-pass" channel for storm water that will not create a diversion of storm water drainage or radically change the watershed boundaries. The drainage scheme presented by those who wish to develop property in the City of Naperville should be planned to accomplish all of the following storm water controls without major loss of land use.

A. The controlled release and storage of excess storm water runoff shall be required in combination for all commercial and industrial developments and for residential developments that contain an area in excess of 2½ acres.

B. The controlled release rate of storm water runoff from all development described in Paragraph A, shall not exceed the existing "safe" storm drainage capacity of the natural downstream outlet channel or storm sewer system. The release rate shall be an average value computed as a direct ratio of the tributary watershed area. This value shall not exceed an average runoff rate of 0.15

B. (Cont'd.) inches per hour which is compatible with the "safe" capacity of the West Branch of the DuPage River and the DesPlaines River. The rate at which storm water runoff is delivered to a designated storm water storage area shall be unrestricted.

C. A "natural" or surface channel system shall be designed with adequate capacity to convey through the development the storm water runoff from all tributary upstream areas. This "by-pass" channel shall be designed to carry the peak rate of runoff from a 100 year storm, assuming all storm sewers are blocked and that the upstream areas are fully developed and have been saturated with antecedent rainfall. No habitable structures shall be constructed within this floodway, however, streets and parking or playground areas and utility easements shall be considered compatible uses.

Design of this floodway system shall also take into consideration control of storm water velocity to prevent erosion or other damage to the facility which will restrict its primary use. Depths of flow shall be kept to a minimum and retention of channel configurations shall be totally under municipal control. In the event that the area within this "by-pass" channel is reshaped or restricted for use as a floodway the municipality will cause to have any restrictions removed at the expense of the party or parties causing said restriction.

Should the development contain an existing "natural" waterway this land configuration shall be preserved as part of the "by-pass" channel system. Construction of a "low Flow" system of storm sewers to carry the minor storm runoff and reshaping of the channel with a maximum of six (6) horizontal to one (1) vertical side slopes and bottom of a width adequate to facilitate maintenance and carry the flood runoff without eroding velocities shall be included in the plans for land development.

D. The required volume for storm water detention shall be calculated on the basis of the runoff from a 100 year frequency rainfall of any duration as published by a recognized agency. This volume of storage shall be provided for the fully developed watershed that is tributary to the area designated for detention purposes. The storm water release rate shall be considered when calculating the storm water storage capacity and the control structure designed to maintain a relatively uniform flow rate regardless of the depth of storm water in the storage area.

E. Dry bottom storm water storage areas shall be designed to serve a secondary purpose for recreation, open space or other types of uses that will not be adversely affected by occasional or intermittent flooding. A method of carrying the low flow through these areas shall be provided in addition to a system of drains, and both shall be provided with a positive gravity outlet to a natural channel or storm sewer with adequate capacity as described in paragraph 2.

The combination of storage of the water from a 100 year storm and the design release rate shall not result in a storage duration in excess of 72 hours. Maximum depth of planned storm water storage shall not exceed four (4) feet unless the existing natural ground contours and other conditions lend to greater storage depth, which shall be approved by the municipality. Minimum grades for turf areas shall be two (2) per cent and maximum slopes shall be 10 per cent (10 units horizontally to one (1) vertically). Storage area side slopes shall be kept as close to the natural land contours as practical and a 10 per cent slope or less shall be used wherever possible. If slopes greater than 10 per cent are necessary to meet storage requirements or area restrictions, approval shall be obtained from the municipality and suitable erosion control provided in addition to the protection required to insure public health, safety and welfare.

Outlet control structures shall be designed as simply as possible and shall require little or no attention for proper operation. Each storm water storage area shall be provided with a method of emergency overflow in the event that a storm in excess of the 100 year frequency storm occurs. This emergency overflow facility shall be designed to function without attention and shall become part of the "natural" or surface channel system described in paragraph 4. Hydraulic calculations shall be submitted to substantiate all design features.

Both outlet control structures and emergency overflow facilities shall be designed and constructed to fully protect the public health, safety and welfare. Storm water runoff velocities shall be kept at a minimum and turbulent conditions at an outfall control structure will not be permitted without complete protection for the public safety. The use of restrictive fences shall be kept to a minimum and used only as a last resort when no other method is feasible.

F. Wet bottom storm water storage areas shall be designed with all of the items required for dry bottom storm water storage areas except that a low flow conduit and a system of drains with a positive gravity outlet shall be eliminated. However, the following additional conditions shall be complied with:

a. Water surface area shall not exceed 1/10 of the tributary drainage area.

b. Shoreline protection shall be provided to prevent erosion from wave action.

c. Minimum normal water depth shall be four (4) feet. If fish are to be used to keep the pond clean, a minimum of ¼ of the pond area shall be a minimum of 10 feet deep.

d. Facilities shall be available, if possible, to allow the pond level to be lowered by gravity flow for cleaning purposes and shoreline maintenance.

e. Control structures for storm water release shall be designed to operate at full capacity with only a minor increase in the water surface level. Hydraulic calculations shall be submitted to substantiate all design features.

f. Aeration facilities to prevent pond stagnation shall be provided. Design calculations to substantiate the effectiveness of these aeration facilities shall be submitted with final engineering plans. Agreements for the perpetual operation and maintenance of aeration facilities shall be prepared to the satisfaction of the municipality.

g. In the event that the water surface of the pond is to be raised for purposes of storing water for irrigation or in anticipation of the evapotranspiration demands of dry weather, the volume remaining for storage of excess storm water runoff shall still be sufficient to contain the 100 year storm runoff.

G. Paved surfaces that are to serve as storm water storage areas shall have minimum grades of one (1) per cent and shall be restricted to storage depths of one (1) foot maximum. Rooftop storage shall be designed with permanent-type control inlets and parapet walls to contain runoff on the rooftop. Emergency overflow areas shall be provided to insure that the weight of water stored will not exceed the structural capacity of the roof. Release rates and storage volume requirements for paved storage areas remain the same as outlined in paragraphs 2 and 3. If a portion of an area within a storm water storage area is to be paved for parking or recreational purposes, the paved surface shall be placed at the highest elevation within the storage area as possible. Maximum parking lot grades shall not exceed normal design parameters of three (3) to five (5) percent.

H. Where developments form only a portion of a watershed or contain portions of several watersheds, the requirement for providing storage shall be based upon the proportion of the area being developed as compared to the total watershed tributary to the storage area. Compensating storage will be acceptable whenever it is justified and feasible. As a watershed is developed with a series of storm water storage facilities, due consideration will be given for calculation of the allowable release rate and capacity of the "natural" or surface channel system as described in paragraph 4.

I. Plans, specifications and all calculations for storm water runoff control as required hereunder shall be submitted to the City of Naperville for review and approval prior to the approval of a final plat, in the case of subdivisions and planned unit developments, or issuance of a building permit, in the case of commercial or industrial construction.

J. Where development of a property presents the threat of flooding or damage by flash runoff to downstream residents, the facilities for storm water runoff control shall be constructed prior to any earthmoving or drainage construction on the project site.

K. The construction of the storm water control system shall be accomplished as part of the cost of land development. If the amount of storage capacity can be increased to provide benefit to the municipality, negotiations for public participation in the cost of development may be feasible.

L. The ability to retain and maximize the ground water recharge capacity of the area being developed is encouraged. Design of the storm water runoff control system shall give consideration to providing ground water recharge to compensate for the reduction in the percolation that occurs when the ground surface is paved and roofed over. Specific design calculations and details shall be provided with the final plans and specifications presented for municipal review. The use of natural gravel deposits for the lower portions of storm runoff storage areas, the flattening of drainage slopes and the retention of existing topography are examples of possible recharge methods.

M. During the construction phases of land development facilities shall be provided to prevent the erosion and washing away of the earth. Silting of downstream areas can be prevented through the strategic use of stilling basins, sodding of runoff channels, and by limiting the period of time during which the earth is stripped of vegetation.

N. Final engineering plans shall show complete details for all of the items covered in this ordinance and shall be submitted for review and approved prior to the start of construction.

12.903 - Penalties: Any person, firm or corporation violating any provision of this article shall be fined not more than $500.00 for each offense and a separate offense shall be deemed committed on each day a violation continues.

Section 2: That except for the amendment to the code as herein provided, all other provisions for the Municipal Code of Naperville of 1960 as amended shal' remain in full force and effect.

Section 3: This ordinance shall take effect and be in full force from and after its passage and approval and publication in pamphlet form.

(EXCERPT)

APPENDIX A-2

Proposed 3-11-74

ENVIRONMENTAL ORDINANCE

TITLE

AN ORDINANCE TO ESTABLISH PROTECTIVE REGULATIONS FOR DEKALB COUNTY'S SOILS, TOPOGRAPHY, VEGETATION, DRAINAGE SYSTEM, FLOODPLAINS, AND FOR OTHER PURPOSES.

Be it ordained by the Board of Commissioners of DeKalb County, Georgia, and it is hereby ordained by the authority of same, that Part II of the Code of DeKalb County be amended by adding Article .

Sec. 1. Purposes.

The purpose of this Ordinance is to assist in the preservation and protection of the natural environment by:

(a) Regulating the alteration of land and topography.

(b) Regulating the removal of vegetation.

(c) Specifying standards for drainage system construction.

(d) Requiring erosion and sedimentation control.

(e) Assuring the continued, efficient operation of the drainage system.

(f) Protecting County streams and flood plains from substantial alteration of their natural functions.

Sec. 2. Definitions.

For the purpose of this Ordinance, the following definitions shall apply:

(1) Words used in the singular shall include the plural, and the plural the singular; words used in the present tense shall include the future tense.

(2) The word "shall" is mandatory and not discretionary.

(3) The word "may" is permissive.

(4) The phrase "used for" shall include the phrases "arranged for," "designed for," "intended for," "maintained for," and "occupied for."

(5) The word "structure" includes the word "building".

(6) Words not defined herein shall be construed to have the meaning given by common and ordinary use as defined by Webster's Third New International Dictionary, copyright 1970.

"As Built" drawings: drawings specifying the dimensions, capacities, and operational capabilities of structures and facilities as they have been constructed.

Available Head: That depth of water which is present at the entrance to the pipe during a 100-year storm.

Bond: A legal instrument which specifies that funds are being held in escrow in accordance with standard bonding conditions by a state approved bonding institution or by DeKalb County as required from developers to assure compliance with the provisions of this Ordinance.

Construction: Any building or erection of a structure or preparation for same.

Design Head: The depth of water at the entrance to the pipe that was used in design to force a rate of flow through the pipe needed in the design.

Developer: Any person who acts in his own behalf or as the agent or an owner of property and engages in alteration of land or vegetation in preparation for construction activity.

Development: Any activity which results in an alteration of either land or vegetation.

Drainage: A general term applied to the removal of surface or subsurface water from a given area either by gravity or by pumping; commonly applied herein to surface water.

Drainage System: The surface and subsurface system for the removal of water from the land, including both the natural elements of streams, marshes, swales and ponds, whether of an intermittent or continuous nature, and the man-made element which includes culverts, ditches, channels, retention facilities, and the storm sewer system.

Erosion: The general process whereby soils are moved by flowing surface or subsurface water.

Exceptional and Historical Trees: Those trees or stands of trees that are exceptional representatives of their species in terms of size, age, or unusual botanical quality; or are associated with historically notable events.

Flood: A temporary rise in the level of water which results in inundation of areas not ordinarily covered by water.

Flood Hazard Map: The official County map designating the elevation and boundaries of flooding under Intermediate Regional Flood conditions

Intermediate Regional Flood Plain: The land area adjoining a river, stream, watercourse or lake which has the probability of being flooded up to and including the Intermediate Regional Flood.

Intermediate Regional Flood: A 100 year frequency flood which has the probability of occurring once every 100 years (which has a one percent chance of occurring each year.)

Live Retention: That quantity of water capable of being effectively contained by a designed facility for a specified period of time.

Owner: The person in whom is vested the ownership, dominion, or title of property; proprietor. This term shall also include a tenant, and any agent of the owner or tenant including a developer.

Person: Any human being, firm, partnership, association, corporation, or governmental entity.

Reach: A longitudinal segment of a stream or river measured along specified points on the stream or river.

Retention Facility: A facility which provides for storage of storm water runoff and controlled release of this runoff during and after a flood or storm.

Runoff: The portion of precipitation on the land which reaches the drainage system.

Runoff rate coefficient: The numerical factor which, when multiplied with the average slope for a particular site, will give the release rate of water from that site.

Scenic Tree Zone: All land located (a) in the Intermediate Regional Flood Plan, (b) in "natural areas" as designated in the DeKalb Comprehensive Plan and (c) up to 150 feet from "scenic roads" as designated by the Board of Commissioners.

Sedimentation: The processes that operate at or near the surface of the ground to deposit soils, debris and other materials either on other ground surfaces or in water channels.

Soils: The upper layer of earth which may be dug or plowed; the loose surface material of the earth in which vegetation normally grows.

Stand of trees: A group of trees in close proximity in a continuous area.

Static Head: The depth of water at the entrance to the culvert when the depth is greater than the diameter of the pipe.

Stream: A natural body of running water flowing continuously or intermittently in a channel on or below the surface of the ground.

Structure: Anything constructed or erected, the use of which requires a location on the ground, or attached to something having a location on the ground, including but not limited to, tennis courts, fences, swimming pools and buildings.

Tree: Any woody plant that has a single or combined trunk with a caliper (diameter) of eight or more inches (8") five feet (5') above the ground and a flowering ornamental tree having a caliper of two or more inches (2") five feet (5') above the ground.

Tree Crown: The outside diameter of a tree's branches.

Tree Permit: The written consent issued by the Development Director authorizing the removal of trees as provided herein.

Vegetation: All plant growth, especially trees, shrubs, mosses and grasses.

Sec. 3. Development Standards.

A. General Requirements.

All persons proposing development or construction on property located in DeKalb County shall be required to:

(1) Submit required information concerning clearing, grubbing, grading, vegetation preservation, erosion and sedimentation control, drainage improvements, maintenance of the Intermediate Regional Flood Plain and maintenance of retention facilities upon project completion

(2) Furnish a bond to be retained by the County until one year's time after completion of development or construction to assure compliance with the provisions of this Ordinance.

(3) Conduct development, construction, and maintenance activities in accordance with approved plans and the requirements of this Ordinance.

B. Preparation of Grading, Vegetation, Drainage, and Erosion and Sediment Control Plans.

Site and construction plans shall be submitted for the Development Director's review showing compliance with applicable provisions before issuance of a development or building permit.

These shall show:

(1) Stands of existing trees as they are to be preserved upon project completion, specifying their locations on the property. A differentiation shall be made between hardwoods and softwoods in the identification of preserved trees. Differentiation shall also be made between existing trees to be preserved and proposed planted trees. Information shall be supplied concerning the proposed destruction of historical or exceptional trees where these exist.

(2) Plans for meeting the grading, drainage, and erosion and sediment control provisions of this Ordinance shall be formulated and implemented under the engineering supervision of a currently State registered engineer.

(3) An engineering report dealing with applicable provisions of this Ordinance clearly setting forth the scope of the engineering problem, the proposed solutions, and pertinent calculations.

(4) An engineering hydraulics analysis of storm water runoff under existing site conditions, under proposed developed site conditions, and a detailed evaluation of the projected effects on property adjoining the site and on existing drainage facilities and systems. Such analysis

shall include a determination of the channel cross section area required to carry the affected stream at the Intermediate Regional Flood stage level within 500 feet of any stream for which an Intermediate Regional Flood Plain has been identified.

(5) The projected sequence of work represented by the grading, drainage, and erosion and sediment control plans as related to other major items of construction.

(6) Delineation of the boundaries and elevations of the Intermediate Regional Flood Plains for streams draining in excess of 100 acres. The Intermediate Regional Flood contour elevation shall be established by engineering field surveys and clearly designated on each site plan and subdivision plat affected by a flood plain drainage easement. In such cases, the actual building site in relationship to the flood plain drainage easement shall be shown.

(7) All engineering design items for storm drainage and erosion control, and delineation of the location of the Intermediate Regional Flood Plains shall meet the applicable minimum requirements of published design standards of DeKalb County, available upon request from the Development Department. Rainfall intensities used in hydrologic computations shall not be less than that shown by applicable rainfall curves published by the National Weather Service.

(8) Upon project completion, "as built" drawings, certified by the professional engineer as to compliance with the approved plans, shall be furnished to the Development Director.

C. Standards.

(1) Development shall be accomplished so as to minimize adverse effects upon the natural or existing topography and soil conditions and minimize the potential for erosion. No site shall be graded except in accordance with approved plans to meet foundation, parking and the drainage requirements of this ordinance.

(2) Plans for development and construction shall minimize cut and fill operations. Construction and development plans calling for excessive cutting and filling may be refused a permit by the Development Department if it is determined that the land uses permitted by the applicable zoning district could be supported with less alteration of the natural terrain.

(3) During development and construction, adequate protective measures shall be provided to minimize damage from surface water to the cut face of excavations or the sloping surfaces of fills.

(4) Fills shall not encroach upon natural water courses, their flood plains, or constructed channels in a manner so as to adversely affect other properties.

(5) Land shall be developed in increments of workable size which can be completed during a single construction season. Erosion and sediment control measures shall be coordinated with the sequence of grading,

development and construction operations. Control measures such as hydro-seeding, berms, interceptor ditches, terraces, and sediment traps shall be put into effect prior to the commencement of each increment of the development/construction process.

(6) Sediment basins (debris basins, desilting basins, or silt traps) shall be installed in conjunction with the initial grading operations and maintained through the development process to remove sediment from run-off waters draining from land undergoing development.

(7) Existing trees shall not be cut or otherwise damaged or destroyed within portions of property to be used for required open space, setback, or buffer requirements of the DeKalb County Zoning Ordinance. Site development shall be accomplished so that significant stands of trees containing five or more hardwoods or fifteen or more softwoods; and exceptional or historical trees are preserved.

(8) Damage to vegetation on stream banks shall be minimized such that all living trees shall be retained within the boundaries of the Intermediate Regional Flood Plain and within five feet on each bank of any stream for which an Intermediate Regional Flood Plain has not be identified. Exceptions to this may include road and utility right of ways, stream retention ponds, and related drainage improvements meeting the flood plain utilization standards of this Ordinance.

(9) In cases where retention of natural trees would create unusual hardship or development problems in open space, setback, and buffer areas, planted trees may be required. The Development Department Director or his designee shall determine when such hardship or development problem exists and may designate that certain areas be replanted in lieu of perserving existing trees.

(10) No paving with concrete, asphalt, or other impervious material within the tree crown zone of trees to be preserved shall be allowed.

(11) Soil and other materials shall not be temporarily or permanently stored in locations which would cause suffocation of root systems of trees to be preserved.

(12) The permanent vegetation shall be installed on the construction site as soon as utilities are in place and final grades are achieved.

(13) The paving of streets, parking lots, and other areas shall be completed in conjunction with final grading for these. Final grading and removal of vegetation shall not occur more than 30 days prior to scheduled paving.

(14) Upon direction from the Development Department, property owners may be required to treat or remove trees suffering from transmittable diseases or pests or allow the County to do so, charging the actual cost thereof to the property owner. The Development Department may not require the removal of trees except for the reasons of disease, infestation and danger of falling.

(15) No person shall remove or cause to be removed any exceptional or historical tree nor any tree located in a scenic tree zone without having obtained a tree permit from the Development Department for the removal of such tree or trees. A tree permit is not required for trees ordered removed by the Development Department.

(16) A combination of storage and controlled release of storm water runoff shall be required for all development and construction.

(17) The release rate of storm water from all developments shall not exceed the storm water runoff from the area in its natural undeveloped state for all intensities and durations of rainfall. The carrying capacity of the channels immediately downstream must be considered in determining the amount of the release. The County will accept a release rate not greater than that calculated from a storm of two (2) year frequency with a runoff rate coefficient of 0.20, 0.25, and 0.35 for land with an average slope of up to 2 percent, 2-7 percent, and over 7 percent respectively.

(18) The drainage system being developed shall have adequate capacity to bypass through the development the flow from all upstream areas for a storm of ten (10) year design frequency for the land upstream under existing development. The bypass flow rate shall be not less than the 10 year flow rate of record or computed using a runoff coefficient of not less than 0.50.

(19) The live retention storage to be provided shall be calculated on the basis of the 100-year frequency rainfall as published by the National Weather Service for the affected area. The retention volume required shall be that necessary to handle the runoff of a 100-year rainfall, for any and all durations, from the proposed development less that volume discharged during the same duration at the approved release rate as specified above.

(20) All free flowing storm drainage systems shall be designed to accommodate the runoff generated by a 100-year design storm without creating static head at the entrance, and to accommodate the runoff generated by a 100-year design storm utilizing the available head at the entrance.

(21) When the County determines that development and construction projects are too small, or engineering, aesthetic, and economic factors make combined retention or other drainage facilites more practical for construction by the County, the County shall require a fee or equivalent dedication of land which the County shall use to construct these facilities. The County may permit several developers to construct joint facilities. The Development Director shall approve or disapprove the waiver of on-site drainage or retention facilities on the basis of the engineering feasibility of a combined facility. The Development Director shall not accept a fee or dedication of land less than (a) the proportionate share for that piece of property in its developed state and (b) the present costs of constructing such drainage or retention facilities.

(22) The County shall have the prerogative of determining the acceptability of alternative methods of storm water retention based on appropriate engineering studies. Well maintained and landscaped lakes may be provided to act jointly as retention reservoirs and recreation facilities or aesthetic focal points within forest preserve areas, County or private parks, housing developments, shopping centers and industrial parks. Other control methods to regulate the rate of storm water discharge which may be acceptable include retention on flat roofs, parking lots, streets, lawns, underground storage and oversized storm drains with restricted outlets.

(23) Retention facilities and drainage structures shall, where possible, use natural topography and natural vegetation. In lieu thereof these shall have planted trees and vegetation such as shrubs and permanent ground cover on their borders. All on-site facilities shall be properly maintained by the owner such that they do not become nuisances. Nuisance conditions shall include: improper storage resulting in uncontrolled runoff and overflow; stagnant water with concomitant algae growth, insect breeding and odors; discarded debris; and safety hazards created by the facility's operation. DeKalb County shall maintain all common and public retention ponds and facilities.

(24) All runoff control structures located on private property whether dedicated to the County or not shall be accessible at all times for County inspection. Where runoff control structures have been accepted by the County for maintenance, access easements shall be provided.

(25) No impoundment of storm water which retains in excess of 0.5 acre feet shall be removed without first obtaining a permit from DeKalb County.

(26) Alteration of land in existing developed areas shall be conducted in such a manner that changes in patterns of natural drainage shall not adversely affect other landowners. This shall prohibit alteration of a natural or public drainageway and no restrictions or barriers including fences, may be placed in these drainageways or flood plains without first obtaining a permit from DeKalb County.

(27) No construction materials or construction by-products shall be discarded in any drainageway or stream.

(28) No permanent structures shall be located within the Intermediate Regional Flood Plain boundaries other than those facilities required and approved by the County which will not conflict with the hydrologic design characteristics of the approved development and construction plans. Land within the Intermediate Regional Flood Plain boundaries may be used to meet setback, yard, open space, and buffer requirements of the DeKalb County Zoning Ordinance.

(29) Land uses within the Intermediate Regional Flood Plain shall not adversely diminish or restrict the capacity of the channels or floodplains of the stream, its tributaries, drainage ditches, or any other drainage facilities or systems and shall not increase the velocity or concentration of flow in downstream areas.

(30) In residential districts not less than 70 percent of the maximum lot area as established by the applicable zoning district development standards shall be above the Intermediate Regional Flood contour elevation, with the exception that lots in the R-150 district shall conform to requirements of the R-100 district; the distance between the Intermediate Regional Flood contour elevation and any part of the dwelling unit shall be not less than 40 feet.

(31) Alteration of the natural terrain of the Intermediate Regional Flood Plain including clearing, grubbing, grading shall be illegal without a development permit issued by the Development Department.

(32) All buildings located adjacent to the Intermediate Regional Flood Plain shall be constructed so that all portions of the structure, including the basement floor or crawl areas, shall be not less than three feet above the Intermediate Regional Flood elevation; however, structural support units may be located within the Intermediate Regional Flood Plain provided they do not conflict with the hydrologic design characteristics of the approved plans and do not conflict with the other requirements of this Ordinance.

(33) The profile elevation of the centerline of all public streets shall be constructed a minimum of one foot above the Intermediate Regional Flood contour elevation. Exceptions to this provision may be granted by the Roads and Drainage Director or his designee, in cases where the construction of the street elevation below the Intermediate Regional Flood contour elevation would improve drainage or reduce the effects of flooding.

(34) Structural storage facilities for chemicals, explosives, buoyant materials, flammable liquids or other toxic materials which could be hazardous to public health, safety, and welfare, shall be located in a manner which will assure that the facilities are situated at elevations above that of the Intermediate Regional Flood Plain.

APPENDIX A-3

MARION COUNTY ORDINANCE NO. 73 - 9

AN ORDINANCE TO REGULATE DEVELOPMENT OF LAND IN THE UNINCORPORATED AREA OF MARION COUNTY, FLORIDA, ALONG A PORTION OF THE RIVER KNOWN AS BLUE RUN; PROVIDING DEFINITIONS FOR THE CERTAIN WORD OR WORDS USED HEREIN; SETTING FORTH THE RECOGNITION OF THE ORDINARY HIGH WATER LINE AS ESTABLISHED BY THE BOARD OF TRUSTEES OF THE INTERNAL IMPROVEMENT TRUST FUND OF THE STATE OF FLORIDA ALONG BOTH SIDES OF THE SOVEREIGN WATER BODY KNOWN AS BLUE RUN; RECOGNIZING AND ESTABLISHING FLOOD PLAIN CONTROL ELEVATIONS BELOW WHICH DEVELOPMENT IS PROHIBITED OR RESTRICTED; REQUIRING SPECIAL PERMITS FOR ANY DEVELOPMENT WITHIN THE 25 YEAR AND 100 YEAR FLOOD PLAIN ELEVATIONS; PROVIDING A SEVERABILITY CLAUSE; AND PROVIDING AN EFFECTIVE DATE.

WHEREAS, The Marion County Zoning Board has recommended to the Board of County Commissioners of Marion County, Florida, that this ordinance be adopted to regulate development of land in the unincorporated area of Marion County, Florida, along a portion of the river known as Blue Run in order that the water quality of the river may be protected, and

WHEREAS, the Board of County Commissioners of Marion County, Florida, has conducted public hearings to determine how best to protect the water quality of Blue Run, and

WHEREAS, it is the conclusion of the Board of County Commissioners of Marion County, Florida, that the runoff of surface storm water into Blue Run is the largest contributing factor to high water turbidity and unfavorable change to the present ecology of Blue Run, and

WHEREAS, it has been determined by the Board of County Commissioners of Marion County, Florida, that the health, safety and welfare of the general public will be best served and the environment of Marion County, Florida, will be best protected by the adoption of this ordinance, and

WHEREAS, Chapter 125, Florida Statutes grants powers to the Board of County Commissioners of Marion County, Florida, to adopt and enforce building, housing, and related technical codes and regulations.

NOW, THEREFORE, be it ordained by the Board of County Commissioners of Marion County, Florida, that;

SECTION 1. DEFINITIONS

When appearing in this ordinance the following word or words shall be interpreted as indicated unless the context clearly indicates otherwise;

BLUE RUN	That certain river also known as Rainbow Run or Rainbow River which originates and has as its primary source the natural springs known as Rainbow Springs located approximately at the center of the East line of Section 12, Township 16 South, Range 18 East, in Marion County, Florida, and terminating, as

SECTION 2. SPECIAL REQUIREMENTS

2.1 No storm drainage facilities, construction of any type, earth excavation or filling, or land clearing shall be permited on any Uplands from which surface storm water runoff naturally drains directly into Blue Run, until a special permit is ussed by the Board of County Commissioners of Marion County. The special permit shall be issued upon the approval of drainage plans showing that surface storm water runoff from the land during and after development will be adequately disposed of on the land by percolation basins or other acceptable methods. Engineering calculations of runoff quantities shall be based on sound engineering principals using the rainfall intensity that is to be expected from a 10 year return frequency storm. Additional information shall be presented to illustrate how the waters of Blue Run shall be protected from degradation during construction.

2.2 No building construction, earth excavation, filling, or land clearing of any kind shall be permitted on land lying below Control Elevation "A" on each side of Blue Run.

2.3 No building construction shall be permitted on land lying between Control Elevation "A" and Control Elevation "B" on either side of Blue Run. Land clearing, excavation, and filling shall only be permitted in said land lying between Control Elevation "A" and Control Elevation "B" on either side of Blue Run by special permit issued by the Board of County Commissioners of Marion County, Florida, which shall not be granted if such clearing, excavation or filling involves more than 50% of the area of the ownership of the applicant and upon a showing that permitted clearing, excavation, and filling will not degrade the waters of Blue Run.

2.4 Land lying between Control Elevation "B" and Control Elevation "C" on either side of Blue Run may be developed providing that;

(1) Residence floors are above Control Elevation "C".

(2) No part of any septic tank or drain field is located on land lying below Control Elevation "B".

(3) No more than 75% of the land on which the special permit is requested is cleared of vegetation existing at the effective date of this ordinance...

SECTION 3. SEVERABILITY PROVISIONS

3.1 If any word, phrase, paragraph, section, or other portion of this ordinance shall be held to be invalid or unconstitutional by any court of competent jurisdiction, such decision shall not affect the validity of the remaining portions of this ordinance.

3.2 Nothing in this ordinance shall relieve any Developer from the requirements of other governmental agencies having jurisdiction in and adjacent to Blue Run including, but not limited to, the United States Coast Guard, the United States Army Corps of Engineers, the Trustees of the Internal Improvement Trust Fund of the State of Florida, the Florida Department of Pollution Control, the Southwest Florida Water Managment District, the Florida Department of Natural Resources, and the Division of State Planning of the Florida Department of Administration.

SECTION 4. EFFECTIVE DATE

4.1 This ordinance shall take effect upon its adoption by the Board of County Commissioners of Marion County, Florida, and its filing with the Department of State of the State of Florida in accordance with the provisions of Section 125.66, Florida Statutes.

far as the applicability of this ordinance, at the city limits of the City of Dunnellon on the South line of the Northwest one-quarter of Section 30, Township 16 South, Range 19 East, Marion County, Florida.

ELEVATION, ELEVATIONS	The vertical height or heights above a datum plane which for the purposes of this ordinance is the Mean Sea Level datum of the United States Coast and Geodetic Survey of 1929.
DEVELOPER	The person or persons, corporation or other business entity applying for a permit to undertake development and performing development within the scope of this ordinance.
LANDWARD	In a direction opposite to that in which Blue Run lies. From a point of reference on Blue Run the word shall mean toward the shore.
DEVELOPMENT	Any activity in the Uplands of Blue Run which would alter the elevation of the land, remove or destroy plan life, cause structures of any kind to be installed, erected or removed, or a change of any kind from the conditions existing as of the effective date of the ordinance, but shall not include bona fide agricultural use or timber management in accordance with good forestry practices.
UPLANDS	Those properties on each side of Blue Run extending from the Ordinary High Water Elevation in a Landward Direction of 500 feet or to ownership limits, but in no event less than 150 feet from the Ordinary High Water Elevation.
ORDINARY HIGH WATER LINE	The line on both sides of Blue Run established by connecting points of varying elevation on the set of plans prepared by the Board of Trustees of the Internal Improvement Trust Fund of the State of Florida and certified to by Herbert Shoun, Registered Surveyor No. 551. This set of plans is referred to throughout this ordinance as Exhibit "A" and is a part of this ordinance as if incorporated herein. The Ordinary High Water Line thus established is considered by the Board of Trustees as the boundary line between the sovereign waters of Blue Run and private Upland ownership and is hereinafter referred to as Control Elevation "A".
FLOOD PLAIN ELEVATIONS	These evaluations established along Blue Run represent the hydraulic gradient for the predicted 25 year, and 100 year flood levels and are shown by means of profiles on Exhibit "B" attached and made a part hereof computed by Southwest Florida Water Management District dated July, 1973. These elevations are to be located on the ground as the point with that elevation as of the effective date of this ordinance. The 25 year flood plain elevation is hereinafter referred to as Control Elevation "B" and the 100 year flood plain elevation is hereinafter referred to as Control Elevation "C".

APPENDIX A-4

LEON COUNTY ORDINANCE NO. 73-10

AS AMENDED BY

LEON COUNTY ORDINANCE NO. 73-57

AN ORDINANCE RELATING TO THE PUBLIC AND PRIVATE CONTROL OF ON-SITE GENERATED EROSION, SEDIMENTATION AND RUNOFF AND THE ACCUMULATION OF DEBRIS WITHIN THE BOUNDARIES OF LEON COUNTY, FLORIDA; INDENTIFYING THE PURPOSE AND INTENT OF THE ORDINANCE; PROVIDING DEFINITIONS; ESTABLISHING GOVERNMENTAL COMMITMENT TO UNDERTAKE AND MAINTAIN A MASTER STORM DRAINAGE PLAN; ESTABLISHING GOVERNMENTAL RESPONSIBILITY FOR MAJOR DRAINAGE WAYS; IDENTIFYING THE RESPONSIBILITY FOR EROSION, SEDIMENTATION, RUNOFF, AND DEBRIS CONTROL; REQUIRING PRIOR APPROVAL OF SITE PLANS PRIOR TO CLEARING OR DEVELOPING ANY LAND IN LEON COUNTY, FLORIDA; ESTABLISHING THE ENVIRONMENTAL ADMINISTRATOR AS THE ENFORCING OFFICIAL; PROVIDING FOR SEVERABILITY; AND PROVIDING AN EFFECTIVE DATE.

WHEREAS, Man's extensive alteration of the landscape -- resulting from the clearing and grading of land and the creation of impervious areas -- and intensive use of land -- resulting from the concentrated spread of urbanization -- without regard to its impact upon the environmental equilibrium has drastically accelerated the natural processes of erosion, sedimentation, and runoff, thereby contributing to (1) the extensive chemical, biological, and physical pollution of water bodies, as readily evidenced by the rapid rate of lake eutrophication; (2) the hazard of ground water supply contamination and elimination; and (3) the irreparable damaging of roads, homes, recreational areas and other valuable personal and real property, both public and private; and,

WHEREAS, Leon County, realizing that it is incumbent upon government, as well as the private individual to solve the problem; will undertake the expedient completion and maintenance of a comprehensive master storm drainage plan for the Tallahassee-Leon County area; and

WHEREAS, Leon County, Florida, has determined that requirements for the control of on-site generated erosion, sedimentation, and runoff and the accumulation of debris within the boundaries of Leon County, Florida, are not only desirable but are essential to insuring the health, welfare and general well being of the community and that such requirements are a proper use of the police power of the county, and,

WHEREAS, additional steps are necessary to establish controls upon the initial change of vegetative cover, requiring the submission of a site plan prior to clearing or developing of any land in Leon County which would set forth the measures to be taken for the control of on-site generated erosion, runoff and sedimentation resulting from such activities, with a permit to be issued by the Board; and

WHEREAS, it appears that enforcement procedures are necessary to allow the Board to control violations of ordinances which occur after the commencement of clearing or development operations.

NOW, THEREFORE, BE IT ORDAINED BY THE BOARD OF COUNTY COMMISSIONERS OF LEON COUNTY, FLORIDA:

Section 1. Purpose and Intent. For the purpose of alleviating the harmful and damaging effects of on-site generated erosion, sedimentation, runoff, and the accumulation of debris on adjacent, downhill or downstream properties, the following shall be accomplished:

(a) Establish the County commitment to undertake and maintain a comprehensive master storm drainage plan for Tallahassee-Leon County.

(b) Articulate County policy regarding (1) the acquisition, construction, and maintenance of major drainage ways within the limits of its jurisdiction, and (2) the installation of temporary and permanent vegetative or structural measures as are necessary to prevent the pollution of water and provide storage for ground water recharge.

(c) Establish responsibility for the alleviation of the harmful and damaging effects of on-site generated erosion, sedimentation, runoff, and the accumulation of debris on adjacent, downhill or downstream properties.

Section 2. Definitions.

2.1 Person - any landowner, lessee, building contractor, developer or other entity involved in the use of real property, including agents, employees, independent contractors or others in privity with any of the above, whether natural persons, corporations, partnerships, joint adventures, governmental bodies, agencies or officials.

2.2 Sediment - solid material having a particle size of .02 millimeters or greater, including but not limited to all organic mineral substances and debris, which is transported by surface water.

Section 3. Responsibility for Erosion, Sedimentation, Runoff, and Debris Control. No person shall change or allow to be changed the contour, topography, use, or vegetative cover of land owned or controlled by him in such a manner that it will cause surface waters flowing from said land to inundate, erode, deposit sediment on or otherwise damage downstream or downhill property, real or personal, owned by others without their consent, or rivers, lakes, streams, or other watercourses without the consent of the applicable governmental authority.

Section 4. Application for Permit.

4.1 Except as exempted in Section 5 below, or where there has been a determination by the Environmental Administrator there has been a determination by the Environmental Administrator that such a plan may not be necessary, any person, who intends to make changes in the contour of any land proposed to be subdivided, developed or changed in use by grading, excavating, removal, alteration, or destruction of the natural topsoil, hereinafter referred to as clearing and development operations, shall, prior to engaging in such operations, submit a site plan showing:

(a) The nature and extent of the proposed clearing, grading and development operations; and

(b) The plans to be implemented by such person for controlling on-site generated sedimentation, erosion and runoff, said plans to be designed to control runoff to prevent damage to downstream property owners and to remove sediment prior to discharge of peak storm runoff from storms having a recurrence frequency of 25 years. Rainfall-intensity curves as developed by the Florida Department of Transportation shall be the basis of design. Designs and calculations for such facilities shall be submitted to the Environmental Administrator upon request.

(c) The plans must comply with all County laws and ordinances.

4.2 Within seven (7) working days after submission of the proposed site plan, acompanied by the necessary application form and permit fee, said fee not to exceed $1.00 acre, subject to a minimum fee of $10.00, the Department of Environmental Services, shall approve, approve with specified conditions and modifications, or reject the proposed plan, and shall notify the applicant accordingly. If the Department fails to act on the application within seven (7) working days after submission to the Department, it shall be deemed approved as submitted. If the plan is rejected, or modified, it must be in consultation with a Professional Engineer and the Department shall state its reasons for rejection, approval with specific conditions, or modification. If the applicant feels aggrieved by its action, he shall be entitled to a hearing before the Board at its next regular meeting, not to exceed fourteen (14) days, after filing a request for hearing with the Board.

Section 5. Exemptions.

5.1 The provisions of Sections 4 through 9 and 11.1 of this ordinance shall not apply to:

(a) Bona fide agricultural or forestry operations, including landclearing operations in connection therewith; provided, however, if said land is subsequently changed to another type of use, the use of said land shall thenceforth be subject to this ordinance.

(b) Home gardening or other minor clearing or excavation work not incident to a substantial change in the existing residential use of the land, which may be reasonably expected not to contribute to any on-site generated erosion or degradation of any lands or water beyond the boundaries of the property of the residence involved.

(c) Emergency repairs, on public or private objects, necessary for the preservation of life, health or property, or taken to implement and accomplish the beneficial purposes of this ordinance as set forth herein under such circumstances where it would be impracticable to obtain approval of the Environmental Administrator prior to making such emergency repairs.

(d) Routine maintenance or repair work on public or private roads or utility line rights-of-way.

5.2 With respect to the clearing and development of single-family or duplex lots in subdivisions which are either platted or have received preliminary plat approval of the Tallahassee-Leon County Planning Commission as of the effective date of this ordinance, the person may either:

(a) Submit a site plan for prior approval and be subject to all of the provisions of this ordinance; or in the alternative,

(b) The person may clear and develop such lot in a two-stage clearing operation, leaving an adequate siltation barrier around the perimeter of such lot until completion of construction and stabilization of said lot. If the Environmental Administrator determines that the siltation barrier is inadequate and that clearing and development of the lot is contributing substantially to on-site generated sedimentation and runoff, the Environmental Administrator may issue a notice to comply as set forth in subsection 7.1 (a) herein, and if such person fails to comply with said notice, the Environmental Administrator may, after seven (7) days written notice to such person, issue a stop work order as provided therein.

5.3 In those instances where the Department has, after the effective date of this ordinance, granted approval to a site plan, subsequent clearing and development within said plan shall not require further approval under this ordinance but shall be subject to the other provisions of this ordinance concerning enforcement and penalties.

Section 6. Adherence to Plan. After approval of the site plan as set forth herein, the person shall be required to adhere strictly to the Plan as approved and shall be required to construct and properly maintain any sedimentation control measures contained on said approved plan. Any changes or amendments to said plan must be approved by the Department in accordance with the procedures set forth in Section 5 above. If the person adheres to said plan including continued maintenance of any sedimentation control measures during the clearing and development operations as approved, he shall not be deemed in violation of this ordinance, due to circumstances beyond his control, but this shall not relieve such person of any civil liability, including injunctive relief, to any aggrieved property owner.

Section 7. Enforcement

7.1 If the Environmental Administrator determines that clearing and development of the land is not being carried out in accordance with the approved plan or that approved sedimentation control measures have not been constructed or are not being properly maintained in accordance with the approved plan, then he is authorized to:

(a) Immediately issue written notice to the person of the nature and location of the alleged noncompliance, accompanied by documentary evidence including photographs demonstrating failure to comply with the approved plan, and specifying what remedial steps are necessary to bring the project into compliance. The person shall immediately, conditions permitting, commence the recommended remedial action and shall have seven (7) working days after receipt of said notice, or such longer time as may be allowed by the Environmental Administrator, to complete the remedial action set forth in said notice.

(b) If the remedial work is not completed within the time allowed, then the Environmental Administrator is authorized to issue a stop work order specifying wherein the noncompliance has occurred and specifying what remedial steps are necessary to bring the project into compliance, said order to be directed to the person, directing him to forthwith cease and desist all or any portion of the work on any geographical portion of the project which is contributing to on-site generated siltation or sedimentation runoff except such remedial work as is deemed necessary to bring the project into compliance.

(c) If the person fails to complete the recommended remedial action within the time allowed, or fails to take the recommended remedial action after the issuance of a stop work order under Section 7.1 (b) then the Environmental Administrator may issue a stop work order on all or any portion of the entire project.

7.2. A copy of any such notice under 7.1 (a) above or stop work order under 7.1 (b) above shall be served upon the person by either personal delivery or certified mail.

7.3 Upon completion of remedial steps required by a notice under 7.1 (a) above, the Environmental Administrator shall forthwith issue a notice of compliance and cancellation of said notice of noncompliance or stop work order.

Section 8. Review of Stop Work Order. Any person who feels aggrieved at any stop work order issued by the Environmental Administrator under this ordinance, or by failure to cancel same after performance of remedial steps, shall have the right to request a hearing within seven (7) days after making said request. At said hearing the Environmental Administrator and the aggrieved person shall present any evidence bearing on the propriety of said stop work order or continuation of same. At the conclusion of the hearing, and based upon the evidence presented to it, the Board shall:

(a) Affirm the stop work order and the remedial steps required therein and direct continuing effect and enforcement of said stop work order until the offending portion of the project has been brought into compliance; or

(b) Affirm the stop work order, but upon such modified remedial steps as the Board may find necessary and appropriate, and direct continuing effect and enforcement of said stop work order until the offending portion of the project has been brought into compliance; or

(c) Reverse, cancel or suspend the stop work order upon a finding that remedial steps are not necessary or that required remedial steps have been taken, or upon a finding that a stop work order is not appropriate or necessary during the performance of required remedial steps.

Section 9. Revocation of Permit. The Board, upon request by the Environmental Administrator at the next regular meeting of the Board, after at least three (3) days notice in writing to the person, may revoke the permit issued pursuant to this ordinance for any project which the Board finds, upon evidence presented to it that the Person has proceeded with work on the offending portion of any project, except specified remedial work to bring the project into compliance with the approved plan, while under a valid stop work order which has neither been reversed, cancelled nor suspended by the Board pursuant to Sections 7 or 8 hereof.

Section 10. Environmental Administrator; Duties. There is hereby created, the position of Environmental Administrator who shall be Head of the Department of Environmental Services and shall be responsible for the enforcement of this ordinance.

10.1 Whenever the Environmental Administrator determines that a violation of this ordinance exists which is not within the provisions of Sections 4 through 9 hereof, he shall take action as follows:

(a) Give written notice of the violation to the person involved in such violation. A copy of such written notice endorsed by him shall be transmitted to the County Attorney.

(b) The notice shall include:

   (1) A description of the location of the property involved, either by street address or by legal description.

   (2) A statement indicating the nature of the violation.

   (3) A statement showing the time within which all necessary remedial action must be accomplished, which time may not be less than seven (7) days nor more than ninety (90) days from the date of such written notice.

   (4) The name or names or the persons upon whom the notice of violation is served.

   (5) A statement advising that upon the failure to comply with the requireme

of the notice, the County shall take such enforcement procedures as may be required under the ordinance.

(c) Service of written notice required by this ordinance shall be deemed complete upon posting of the notice by certified mail, return receipt requested, to the last known address of such person.

(d) If such order is not complied with within the time specified in the order, then the Environmental Administrator shall use all available means of enforcement provided herein in order to secure compliance with the provisions of this ordinance including the punishment for its violation.

Section 11. Penalties

11.1 It shall be unlawful for any person to:

(a) Engage in clearing and development work without a permit as provided herein; or

(b) Continue work of the offending geographical portion of a project after receipt of a stop work order, other than remedial work to bring the project into compliance, unless said stop work order is reversed, cancelled or suspended by the Board; or

(c) Fail to complete the recommended remedial action within the time allowed under those circumstances set forth in subsection 7.1 (c) above.

11.2 Any person violating this ordinance shall be punished according to law. Each day such violation continues shall constitute a separate offense. Any person may seek an injunction against any violation of the provisions of this ordinance, and recover such damages as he may suffer, including but not limited to the cost of removal of any debris or sedimentation caused by such violation.

Section 12. Repealer. All Ordinances or parts of ordinances in conflict herewith be, and the same are expressly repealed.

Section 13. Severability. If any section, subsection, clause or phrase of this ordinance is for any reason held unconstitutional or invalid, the invalidity thereof shall not affect the validity of any of the remaining portions of this ordinance.

Section 14. Amendment and Revision. This ordinance shall be reviewed annually by the Environmental Commission and specific amendments and revisions recommended to the Board as conditions and technology change.

(EXCERPT)

APPENDIX A-5

SUBDIVISION REGULATIONS

Tallahassee and Leon County, Florida

11.2.10 Drainage

a. Terms -

(1) The ten (10) year storm is as defined in the Florida Department of Transportation Drainage Manual rainfall intensity - duration curves for the Tallahassee area.

(2) The twenty-five (25) year storm is as defined in the Florida Department of Transportation Drainage Manual rainfall intensity-duration curves for the Tallahassee area.

b. General -

A complete storm water management system shall be provided in all areas of the subdivision for handling storm water runoff that flows into or across the subdivision from the outside, without undesired additional flooding of any other lands in the drainage basin. Soil types shall be considered and ultimate land usage assumed for selection of proper runoff coefficients within the basins involved. The system shall be designed in accordance with accepted engineering principles for design floods resulting from rain storms of the maximum intensity predicted for the Leon County area at twenty-five (25) year intervals for major water management facilities, which come under the Leon County or City of Tallahassee Engineering Department, and ten (10) year intervals for all other water management facilities required for the subdivision. The system shall be designed for long life, low maintenance methods, and shall be constructed to conform to the Leon County Erosion, Runoff and Sedimentation Control Ordinance and to standards specified herein. All increased runoff due to development of the land which exceeds the capacity of the percolation areas, up to and including the runoff from a twenty-five (25) year storm, shall be diverted into retention areas for future percolation areas, seepage basins, and retention areas to handle the runoff from storms which exceed the twenty-five (25) year storm in duration and severity.

All drainage systems shall include special engineering design features to minimize pollution and oil, suspended solids and other objectionable material in storm water runoff. Treatment or retention facilities shall be designed by an engineer to adequately treat the storm water runoff resulting from rainstorms of the maximum intensity predicted for the Leon County area at twenty-five (25) year intervals for all other drainage ways and ten (10) year intervals for all other drainage ways and shall be subject to approval by the City or County Engineering Department and Environmental Administrator prior to construction.

c. Consideration of Soil and Flood Hazards -

A subdivision plan shall not be approved unless all land intended for use as building sites can be used safely for building purposes, without danger from flood or other inundation or from adverse soil or foundation conditions or from any other menace to health, safety, or public welfare. In particular, lands which are within the twenty-five (25) year flood plain, as determined by an engineer based on the best available data, shall be subdivided and developed only after proper provision is made for the protective flood control measures and water management facilities necessary for flood-free development and for flood-free vehicular access to such sites. The twenty-five (25) year flood plain is any land area, usually adjoining a lake, river, stream, or water course which is likely to be flooded, on the average, once every twenty-five (25) years. No platted lot shall be approved that does not contain a suitable building site sufficient elevation to permit construction utilizing a first floor elevation above the level of the twenty-five (25) year flood as determined by an engineer based on the best available data. Where the floodway of any stream or river is defined, lots shall be platted for residential use only if all parts of platted lots located within the floodway are expressly limited to open space use. The floodway is the unobstructed cross sectional area necessary to convey flood flows for a particular flood discharge.

d. Right of way Drainage -

The developer shall provide adequate positive drainage, as approved by the City and/or County Engineering Department, to all areas of the right of way. The developer shall construct, install, and furnish all necessary drainage structures to include pipes, catch basins, ditches, etc. as required. Construction shall conform to City and/or County Engineering Department specifications.

e. Street Drainage -

All roads and streets shall be well drained with ample size culverts and ditches as approved by the City and/or County Engineering Department.

f. Outfall -

The drainage system shall tie generally to existing drainage facilities covered by City or County easement or into already established natural drains not covered by City or County easements where there is no question that the natural drain served the area within the subdivision being developed and that said drainage will not result in damage to any property rights of others. A statement to that effect shall be made by an engineer. Discharge onto adjacent properties where there is no existing drainage outlet or where no natural drains exist will not be permitted without the developer acquiring the necessary easements, as determined by the City and/or County Engineering Department, to point satisfactorily to the County. All calculations shall be based on a twenty-five (25) year frequency rainfall for all open ditch systems. Protection against scour and erosion shall be provided as required.

Where an outfall is utilized which discharges into (a) a lake, or (b) a canal or stream which flows into a lake within one mile, the first one-half inch of rainfall from each storm shall be retained and either percolated into the ground, collected and evaporated, or given chemical-physical treatment to minimize pollution prior to being discharged from the outfall. Outfalls into lakes shall be designed to prevent lake bottom scour.

g. Paved Ditches -

All ditches on a grade of 3.0 percent or steeper shall be paved.

h. Enclosed Storm Sewer -

Enclosed storm sewer systems shall be concrete pipe unless otherwise specified by the City and/or County Engineering Department.

i. Culver Clearance -

Minimum culvert and storm sewer clearance shall be one foot between bottom of the road base and the outside crown of the culvert.

j. One-Lot Percolation -

Lots shall be developed to maximize the amount of natural drainage which is percolated into the soil and to minimize direct overland runoff into adjoining streets and water courses. Storm water runoff from roofs and other impervious surfaces should be diverted into swales,or terraces on the lot when possible. Whenever land within 200 feet or a lake and sloping toward said lake is developed, terraces sloping away from the lake, a tree line, or other acceptable means shall be provided to minimize storm water runoff into the lake.

k. Retention-Seepage Basins

(1) General - Where a positive outfall is unavailable or inadequate and the installation or revision of the outfall is not economically practical, a retention-seepage basin may be included in the drainage system. The basin shall be designed using accepted engineering practices. In all cases the basin shall be designed and located in such a manner as to cause the least amount of damage when the design storm is exceeded.

(2) Right of Way Requirements - Sufficient drainage right of way shall be set aside to allow for egress, ingress, and a contínous 20 foot maintenance berm around the perimeter of the basin.

(3) Drainage Analysis - The subdivision construction plans must be accompanied by a basin analysis showing:

(a) Overall drainage layout

(b) Storm water analysis

1. Inflow curve
2. Discharge curve
3. Storage available and required
4. Maximum water depth
5. Maximum time or retention

(c) Complete detail of the proposed basin

(d) Percolation data

(e) Soil borings

(4) Structural Requirements - Endwalls shall be provided on each structure entering or leaving the retention area.

(5) Sideslopes - A maximum of 4:1 sideslopes shall be used on all man-made basins. Where natural basins are existing, the criteria will be set on an individual basis.

(6) Slope Protection - The basin sideslopes shall be grassed and mulched in accordance with current DOT Standard Specifications. All areas adjacent to the basin shall be graded to preclude the entrance of storm water runoff except at locations provided for.

(7) Fencing - All retention basins shall be fenced according to standards established by the City and/or County Engineering Department.

TECHNICAL ASSISTANCE APPENDICES

Many of the lists included here were taken from The National Wildlife Federation, William E. Clark, ed. Conservation Directory, 1974, Washington, D.C. 1974.

The directory is a list of organizations, agencies and officials concerned with natural resource use and management. It is an outstanding compilation of names of organizations, both public and private, that can render technical assistance.

APPENDIX B

Agriculture Hand Book No. 305. *Professional Workers In State Agricultural Experiment Stations And Other Cooperating State Institutions.* Washington, D. C.: Cooperative State Research Service, U.S.D.A., revised Dec. 1972.

COOPERATIVE EXTENSION SERVICE

1) ALABAMA: Cooperative Extension Service In Agriculture
Auburn University
Auburn, Alabama 36830

Director: Mr. R. R. Jones (205-826-4958)

2) ALASKA: Cooperative Extension Service Director: Dr. J. W. Matthews
University of Alaska (907-479-7246)
Fairbanks, Alaska 99701

3) ARIZONA: Cooperative Extension Service Director: Dr. G. E. Hull
University of Arizona (602-884-2711)
Tucson, Arizona 85721

4) ARKANSAS: Agricultural Extension Service Director: Mr. C. A. Vines
P. O. Box 391 (501-376-6301)
Little Rock, Ark. 72203

5) CALIFORNIA: Agricultural Extension Service-Director: Mr. G. B. Alcorn
319 University Hall (415-642-7252)
Berkley, California 94720

6) COLORADO: Cooperative Extension Service Director: Mr. L. H. Watts
Colorado State University (303-491-6281)
Fort Collins, Colorado 80521

7) CONNECTICUT: Cooperative Extension Service-Director: Mr. E. J. Kersting
University of Connecticut (203-486-2917)
Storrs, Conn. 06268

8) DELAWARE: Agricultural Extension Service Director: Dr. S. M. Gwinn
University of Delaware (302-738-2502)
Newark, Del. 19711

9) FLORIDA: Agricultural Extension Service Director: Dr. J. N. Busby
University of Florida (904-392-1761)
Gainsville, Florida 32601

10) GEORGIA: Agricultural Extension Service Director: Dr. C. P. Ellington
University of Georgia (404-542-3824)
Athens, GA 30601

11) HAWAII: Agricultural Extension Service Director: Dr. C. P. Wilson
University of Hawaii (808-944-8257)
Honolulu, Hawaii 96822

12) IDAHO: Cooperative Extension Service
University of Idaho
Moscow, Idaho 83843
Director: Mr. J. L. Graves
(208-885-6436)

13) ILLINOIS: Cooperative Extension Service
University of Illinois
Urbana, Ill. 61801
Director: Dr. J. B. Claar
(217-333-2660

14) INDIANA: Cooperative Extension Service
Purdue University
Lafayette, Indiana 47907
Director: Dr. H. G. Diesslin
(317-749-2413)

15) IOWA: Cooperative Extension Service
Iowa State University
of Science and Technology
Ames, Iowa 50010
Director: Dr. M. A. Anderson
(515-294-2518)

16) KANSAS: Cooperative Extension Service
Kansas State University
Manhattan, Kansas 66506
Director: Dr. R. A. Bohannon
(913-532-5820)

17) KENTUCKY: Cooperative Extension Service
University of Kentucky
Lexington, KY 40506
Director: Dr. J. L. Ragland
(606-257-2833)

18) LOUISIANA: Cooperative Extension Service
Louisiana State University
Baton Rouge, LA 70803
Director: Mr. J. A. Cox
(504-388-4141)

19) MAINE: Cooperative Extension Service
University of Maine
Orono, Maine 04473
Director: Mr. E. H. Bates
(207-581-7200)

20) MARYLAND: Cooperative Extension Service
University of Maryland
College Park, Maryland 20742
Director: Dr. R. E. Wagner
(301-454-3742)

21) MASSACHUSETTS: Agricultural Extension Service
University of Massachusetts
Amherst, Mass. 01002
Director: Dr. A. A. Spielman
(413-545-2211)

22) MICHIGAN: Cooperative Extension Service
Michigan State University
East Lansing, Mich. 48823
Director: Mr. G. S. McIntyre
(517-355-2308)

23) MINNESOTA: Agricultural Extension Service-
University of Minnesota
St. Paul, MN 55101
Director: Dr. R. H. Abraham
(612-373-1223)

24) MISSISSIPPI: Cooperative Extension Service-Director: Mr. W. M. Bost
Mississippi State University
of Applied Arts & Sciences (601-325-5455)
State College, Miss. 39762

25) MISSOURI: Cooperative Extension Service Director: Assoc. Dean of Col.
University of Missouri Agr. for Ext.: Dr. S. H. Bodenhamer
Columbia, MO 65201 (414-882-4452)

26) MONTANA: Cooperative Extension Service Director: Mr. T.S. Aasheim
Montana State University (406-994-3681)
Bozeman, Montana 59715

27) NEBRASKA: Cooperative Extension Service Director: Dr. J. L. Adams
University of Nebraska (402-472-2966)
Lincoln, Nebraska 68503

28) NEVADA: Cooperative Extension Service Director: Dr. D. W. Bohmont
University of Nevada (702-784-6611)
Reno, Nevada 89507

29) NEW HAMPSHIRE: Cooperative Extension
Service Director: Dr. M. C. Heckel
University of New Hampshire (603-862-1520)
Durham, N. H. 03824

30) NEW JERSEY: Agricultural Extension Service-Director: Dr. [illegible]. L. Gerwig
Rutgers University (201-247-1766)
New Brunswick, NJ 08903

31) NEW MEXICO: Cooperative Extension Service-Director: Dr. P. J. Leyendecker
New Mexico State University (505-646-0111)
Las Cruces, N. M. 88003

32) NEW YORK: Cooperative Extension Service Director: Dr. E. H. Smith
Cornell University (607-256-2117)
Ithaca, NY 14850

33) NORTH CAROLINA: Cooperative Extension
Service Director: Dr. George Hyatt, Jr.
North Carolina State Univ. (919-755-2811)
Raleigh, NC 27607

34) NORTH DAKOTA: Cooperative Extension
Service Director: Mr. A. H. Schultz
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